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Custom PC Issue 154

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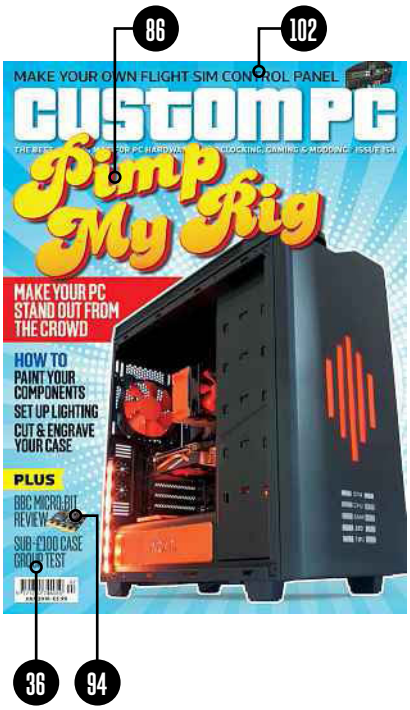

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BEN HARDWIDGE / FROM THE EDITOR

LED THE WAY

LEDs are taking over the tech world, and Ben Hardwidge loves it

It's difficult to believe that most of the significant progress in LED technology has been made in my lifetime, but in the space of just three decades, the humble pair of wires with a light in the middle has gone from being (for many people) a handy indicator for on/off switches to being a foundation stone of the modern tech world. We used to just have red, yellow and green ones, but we've since developed blue, UV and white LEDs, and now the RGB ones that proliferate in PC tech at the moment, while also increasing their brightness without a huge energy cost.

LEDs now account for the majority of bike lights, and they're taking over from traditional filament bulbs around the home, while also providing the backlights for our TVs and working as camera flashes. I'm starting to wish I'd bought shares in LED manufacturers ten years ago. What really interests me about the LED, though, is how it's completely changed fashions in the PC enthusiast market.

Lights aren't a new idea in PCs, of course. When **Custom PC** first started, there was a trend for putting large cold cathode lights in your PC. You'd put a coloured cold cathode strip light in the base of your case, hook it up to a Molex connector and it would illuminate the inside with an eerie glow.

It was a fun novelty for a couple of years, but cold cathodes quickly went out of favour. People started to think they looked tacky and crude, like the animated GIFs that used to cover websites in the 1990s – they looked like gratuitous frills. I'll confess that I wasn't entirely happy about this change in fashions – I like gratuitous frills, so the following trend of unlit, standard-looking PCs didn't particularly inspire me.

Then, a couple of years ago, LEDs started cropping up. I can't put my finger on exactly where it started, but keyboard backlights for membrane keyboards were definitely part of the beginning, with the argument that the light made it easier to see your keys at a darkened LAN event. Then Cherry developed a way to embed LEDs in its mechanical switches, and other manufacturers started doing the same with their switches. Soon after, LED strips for PCs started becoming popular, with recent magnetic designs removing the need for unsightly sticky tape.

Fast forward to now and nearly every peripheral manufacturer is emphasising its LED system just as much as the tech inside its devices. There's no shame in it. Everyone knows that the RGB lighting system on a headset, such as Razer's recently announced ManO'War (see p15) has no practical benefit whatsoever, yet the lighting control software and 16.8-million colour capabilities of the LEDs are seen as significant.

> There's no shame in it. Everyone knows the RGB LEDs on a headset have no practical benefit

Likewise, you pay a premium for decent RGB keyboard backlighting on a top-end keyboard such as Corsair's new K70 RGB Rapidfire (see p21), and you expect a premium PC such as Overclockers' new Asteroid (see p56) to sparkle with LEDs. Even top-end motherboards, such as Asus' new Maximus VIII Hero Alpha (see p22) come with specific headers to power and control RGB LED strips.

Being a fan of gratuitous frills that look fancy, I'm loving this particular fashion and it provides another great way to colour-match your PC's insides too. I've fitted blue LED strips in my PC, as well as threading blue LEDs into my GPU and CPU waterblocks to make them light up, all matched by the blue LEDs on my Corsair K70 keyboard. But let's not kid ourselves. It likely is just a fashion. How long will it be until RGB LEDs are seen as tacky and crude, and we go back to boring, standard-looking tech again? CPC

Ben Hardwidge is the editor of Custom PC. He likes PCs, heavy metal, real ale and Warhammer 40,000. editor@custompcmag.org.uk @custompcmag

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RICHARD SWINBURNE / VIEW FROM TAIWAN

A NUC FOR GAMING?

Intel claims its latest Skull Canyon NUC system is good for gamers, but Richard Swinburne isn't impressed

The Intel NUC NUC6i7KYK, dubbed Skull Canyon, comes out this month, featuring the latest Intel Core i7-6770HQ with Iris Pro 580 graphics – the GPU has a fat count of 72 execution units, and the chip uses L4 eDRAM cache. Skull Canyon is packed with other great kit too, including dual-band 802.11ac Wi-Fi and Gigabit Ethernet, as well as space for two M.2 SSDs and up to 32GB of DDR4 memory. It's a bit limited by having just four USB 3 ports, but the Thunderbolt 3 port doubles as a USB 3.1 port via a USB-C connector.

However, Intel has shoved all that high-tech gear kit into a cheap plastic box, which makes you wonder if it's really worth the $650 US asking price (around £445), especially as you'll also have to pay for memory and storage on top of that cost. The least Intel could have offered was some brushed aluminium, but instead, the only nod towards fancy looks comes from some angles and hexagons, and a skull logo – the design itself isn't terrible, but it needs more than just plastic.

What's more, because *every* edge of the Skull Canyon box is angular, there's no way to stand it on its end like a book, so it can only be placed flat on the desk. Thankfully, there's a VESA mount in the box, but these mounts are rarely used outside certain business needs.

Intel pitches Skull Canyon as being suitable for media playback, content creation, workstation use and gaming – a wide spread of uses.

Media playback will be fine, especially with an HDMI 2 output, but the other quoted uses might prove problematic.

For starters, the skull fascia clearly isn't suitable for business and professional use, but Intel does provide a replacement lid. The end result might not look swanky, but at least it looks neat and discreet. Workstation performance, meanwhile, will be good compared with many very small systems, but it isn't as though this CPU can really offer equivalent multi-threading performance with an LGA2011 desktop system.

> Intel's already ambiguous '30x better' claim is only measured using the Cloud Gate test in 3DMark

It's the gaming angle I have real trouble accepting though. For starters, Intel's already ambiguous '30x better' claim is only measured using the Cloud Gate test in 3DMark, rather than real games, and only refers to the performance of previous Intel chips, rather than discrete GPUs. Yes, Intel does run big eSports events, but those events focus on its CPUs – the gamers in attendance don't use Iris Pro graphics.

Also, at the software level, Intel continues to offer next to nothing for gamers, as its driver releases remain so low-key that they're practically subterranean. Intel doesn't bother with any game tie-ins, or syncing driver releases with new games, and the control panel is increasingly being left further behind the advances made by AMD and Nvidia. What's the real purpose of Iris Pro in this system? It's not as if the average Intel graphics systems can't already handle all HTPC and business needs. Since eDRAM benefits the CPU, bring it to lower-cost parts and ignore the GPU.

I've read an argument that you could use the Thunderbolt 3 port for external graphics, but I don't buy it. Why would you opt for an expensive small form factor system with the best Intel graphics has to offer, then opt for a big, separate box with PCI-E graphics card? It isn't like a laptop, where you get the benefit of a full portable computer with a screen.

Skull Canyon might improve on previous NUC systems, but I'd still rather save hassle and money, and get much better performance, from a mini-ITX rig with desktop-class components. CPC

Richard has worked in tech for over a decade, as a UK journalist, on Asus' ROG team and now as an industry analyst based in Taiwan @Bindibadgi

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Letters

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No surround?

I've been a subscriber since I picked up Issue 135 and read it from cover to cover, which is unusual for me, as I usually browse and cherry pick articles. I'm admittedly not a particularly long-term reader, but in that time, your magazine has reignited a fire in my belly, got me through heart surgery and consequent recovery (at the ripe old age of 39), all while planning my global domination! Or at least planning to build a new rig to save me from playing Elite: Dangerous on a MacBook with Boot Camp.

Today, I await delivery of a second GTX 970 card, along with a 4K monitor, to finish off my beast. My build, as of today, will be largely similar to your Skylake build in Issue 146, with some tweaks as a result of the march of time and independent research. Thanks for the inspiration and guidance. Anyway, get to the point Stew. How about a roundup or review of gaming or PC-based surround-sound systems?

STEWART AYERS

Would you like to see a Labs test of 5.1 speaker systems? If so, then tell us!

Ben: Thanks for your kind comments Stew, and good luck with your build – that pair of GTX 970 cards will make 4K gaming great, and I'm glad to hear we've inspired you. To answer your question, we've generally steered clear of PC surround-sound systems in the past few years, as our reader feedback showed that people were more interested in stereo setups than surround ones.

We've seen an interesting shift here – ten years ago, there were loads of PC surround-sound sets that connected to analogue 3.5mm jack plugs, but the number has really shrunk now, while loads of stereo (and 2.1) sets are available. Surround headsets are proving popular though. I think part of the reason is space – people might have space for a surround-sound system for movies in the lounge, with a proper AV receiver, but often don't have that kind of space around their PC – I know I don't. I'd be interested in any feedback from our readers here though – if enough people are interested in us doing a 5.1 PC speaker roundup, then we'll do one.

Using an old cooler

First, here's a photo from a recent build that may amuse you. What do you do when it's 'build day' and your anti-static mat keeps rolling up? This photo represents start of a complex build/rebuild day, involving combining two old machines, plus old and new parts, into three new machines.

I was left with a new Skylake 6700K system needing a cooler, and a near ten-year- old Thermalright Ultra-120 Extreme needing a new home. I have very fond memories of this cooler – it helped me to get an E6600 to 3.78GHz back in the Core2 days, so I decided to give it a go in the Skylake system.

What do you do when it's 'build day' and your anti-static mat keeps rolling up?

Unfortunately, there's a delay of a few weeks while I wait for the required mounting bracket, so I wanted to ask if I'm being silly here. I remember this cooler being class-leading back in its day, but due to its age, I'm having difficulty finding any indications of how well it might perform next to modern coolers on modern chips. In fact, due to the several generations of change in both coolers and chips, it's hard to know how air-cooling performance has changed in absolute terms over the years. Do you have any experience using this venerable cooler on modern hardware? If not, would you be interested to know how I get on?

GEORGE DAVIES

Ben: I'm afraid I have no experience of using a Thermalright Ultra-120 Extreme on modern hardware, but unless you plan to overclock your Core i7-6700K to ridiculous levels, you may well find that it does the job fine. After all, it's just a heatsink strapped to a CPU, and your starting point is already pretty powerful. I would definitely fit a 120mm fan to it, although a low-speed, quiet fan will hardly make any noise anyway.

The Core i7-6700K does have a higher TDP of 91W, compared to the Core 2 Duo E6600's 65W, and the hotspots will be different too, with more cores, an integrated GPU and a very different cache system in the Core i7 chip. I reckon it will work as long as you have a fan on it, and yes, let us know how you get on. Our general experience with older air coolers is that they're very much outperformed by new models now, but the old ones should still do the job as long as you don't exceed their rated TDP. Let us know how you get on.

> It's like buying a car with a great paint scheme, and only seeing the floorpan and exhaust system

Why are cards upside down?

I was wondering manufacturers of graphics cards and sound cards always make their products 'upside-down.' When installed in the typical rig, the best-looking bits – the bright casings and fans – are hidden, and all you see is a nicely floodlit printed circuitboard and a lot of solder. It's like buying a car with a great paint scheme and only seeing the floorpan and exhaust system. Why can't they have a full casing or simply make them the other way up?

MARTIN TURNER

Photo credit: Konstantin Lanzet

16-bit ISA cards, such as Creative's AWE64, had the components the 'right way up' rather than facing downwards

Ben: That's an interesting question, Martin. Crusty old PC enthusiasts such as myself remember when expansion cards weren't like this. The old ISA (8-bit and 16-bit) cards used to have the components the 'right way up', and that changed when PCI cards arrived later. During the crossover, lots of motherboards had both PCI and ISA slots, the latter usually at the bottom, the former at the top and sometimes an either/or slot with both types of slot next to a single backplate.

As the width of the backplate provides some breathing space between cards to prevent shorting, making PCI cards 'upside down' meant you could have both types of card next to each other on the same motherboard, and without their solder points shorting each other out. The design has never changed since, possibly for no reason other than 'that's the way it's done', but possibly also because dust tends to settle on the top of cards, rather than the bottom, so it's better for the side without fans to get dust on them. Also, modern case designs tend to have intake funs at the bottom, and a graphics card fan then pulls this cool air over the GPU. CPC

Twitter highlights

Follow us on Twitter at @CustomPCmag

_upthesaddlers Can confirm mug is noodle approved.

AlexOGrady Help! I can't find a decent Z170 Micro ATX motherboard with 2 Ethernet ports. 1 for Synology NAS, other for interwebs, options?
Ben: These days, I'd just connect all of them to my router so that my other devices can all share the both the NAS and the Internet connection. Assuming you don't have a router, though, your options are going to be pretty limited in the micro-ATX world (as you've found). You may well be better off just installing a 2x PCI-E network card to use in addition to the port on the board.

QwertyDesignUK First 60 @CustomPCMag from back in October 2003 when AMD were the kings of the CPU.

Ben: Very nice! AMD's AMD64 architecture was fantastic against Intel's NetBurst. I'd love to see AMD come back with a competitive new CPU architecture.

tfk80 Ace timing on the gaming laptop Lab test. Eye was on a Razer Blade. No UK availability. Hello Aorus X3 v5 in that case.
Ben: Glad to be of service – enjoy your new laptop, the Aorus is excellent.

kajun_cheng New @CustomPCMag arrived, excellent, new toilet reading material! Good times!
Ben: Haha, if I had a pound for every time a reader told me they read the mag on the bog ...

simonchild So James Gorbold keeps his NAS in the 'garage or loft'. I presume he chips the ice regularly in winter? #nevermindthedusteither

georgebaily Stunning in-game imagery from @CustomPCMag HTC Vive VR.....

Ben: To be fair, I did address this very issue in my column in that issue! You really do need to try VR for yourself.

PCEnthusiast UK Thrilled to finally become a @CustomPCMag @foldingathome team member. Still new to the subject. Everyone's got to start from somewhere.
Ben: They do indeed – great to have you on board.

WHEN'S THE NEXT MAG COMING OUT?
Issue 155 of **Custom PC** will be on sale on Thursday ,16 June, with subscribers receiving it a few days beforehand.

JUNE 16

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TRACY KING / SCEPTICAL ANALYSIS

AVATAR DIVERSITY

Tracy King looks at indie survival game, Rust, which assigns you a fixed skin colour and gender at random, linked to your Steam ID

Back in 2012, writer John Scalzi wrote an article called Straight White Male: The Lowest Difficulty Setting There Is. An instant viral hit, the piece challenged readers to think of their birth-given attributes as difficulty settings in WoW. If you're straight, white and male, you're playing life on the easiest setting.

The Scalzi solution worked for a little while, but soon became popular enough that the people at whom it was aimed could start to say 'yeah, yeah, difficulty setting blah' and point out that life isn't actually a video game. But you know what *is* a video game? Rust!

And Rust, an indie survival game I like to think of as Sims-meets-Minecraft, is Scalzi's article taken literally. A majority of games force you to play as a white male, and when customisation is available, it's often excessive.

Rust developer Facepunch Studios believes customisation often comes at the expense of actual gameplay, and so it took a very different approach, capturing the attention of the media and angry gamers alike. Rust players are assigned a fixed skin colour and gender at random, linked to their Steam ID. If your avatar is a black woman and you really don't want to be seen in-game as a black woman, tough.

Facepunch Studios believes customisation often comes at the expense of gameplay

It's the first time I've seen game developers force players to play as an ethnicity or gender they're not ... oh wait, hang on, no. Almost every game I've played has done that! It's just that usually I'm forced to play as a white man, *Steve*.

Games which force you to play as a woman and/or a minority race exist, of course, but they're exceptions to the default, so Rust seeks to balance this imbalance. Predictably, a lot of players complained and a lot of articles were written. Facepunch Studios also reported a 74 per cent increase in sales.

It did occur to me that the players complaining about having to play as a female avatar may have a warped point. It's absolutely the case that women online receive more abuse than men. Recent research from The Guardian showed that, although the majority of its regular opinion writers are white men, 'we found that those who experienced the highest levels of abuse and dismissive trolling were women and black men'. It's possible that Rust players perceive white male avatars as having an in-game advantage, or black or female avatars as being likely targets of griefing.

I put this point to Facepunch's Garry Newman, who said, 'It would be interesting to see any kind of correlation between sex and survival chances, but right now, it seems men and women are having equal luck.'

So, in theory, any perceived disadvantage would quickly be dispelled through gameplay. Newman confirms 'if targeting only female avatars led to surviving better in the game, then they would get targeted more. As it is, they're not weaker, more vulnerable or more lucrative to kill, so it's not something that profits the player'.

I hope this theory is borne out in practice, although as the old marketing saying goes, perception is reality. I'd be surprised if female avatars weren't targeted more, although perhaps players knowing that in-game gender means nothing has a tempering effect. It's hard to leave biases at the door though. Still, if Rust's sales continue to increase, perhaps its tactic will be adopted by other studios and we'll finally see an end to the default male character. CPC

Gamer and science enthusiast Tracy King dissects the evidence and statistics behind popular media stories surrounding tech and gaming @tkingdoll

Incoming

We take a look at the latest newly announced products

AMD announces dual-GPU card

In a bid to claim the 'fastest graphics card in the world' title, AMD has stuck two of its HBM-equipped GPUs on a single PCB, along with a PLX chip, to make the new Radeon Pro Duo. The card's Fiji XT GPUs are each clocked at 1GHz and have 4,096 stream processors, making for a total of 8,192. Meanwhile, the 8GB of HBM memory (4GB per GPU) is clocked at 500MHz (1GHz effective), and communicates through a pair of 4,096-bit interfaces. AMD is targeting the card particularly at VR users – both gamers and developers.

Like AMD's Fury X cards, the Pro Duo includes an all-in-one liquid cooler with a 120mm radiator. Not surprisingly, it requires lots of power, with the card sporting three 8-pin PCI-E power sockets, and AMD quoting typical power usage of 350W. It isn't cheap either, with Sapphire's Fury Pro Duo card costing £1,300 inc VAT from **www.overclockers.co.uk**. Samples are currently thin on the ground, but we hope to get a Pro Duo for testing in our next issue.

Phanteks Evolv evolves

Phanteks has updated its Enthoo Evolv ATX case with a new Glass Edition, which features tempered glass side panels. Taking on the likes of In Win, the panels are made entirely from glass, giving a window into the whole of the interior, so you'll need to make sure your cabling is tidy. The case also features RGB LED lights, which can cycle through a choice of ten colours. The Enthoo Evolv ATX Glass Edition is available for pre-order now for £155 inc VAT from **www.overclockers.co.uk**

PC Specialist launches water-cooled PCs

UK system builder PC Specialist has launched a new series of water-cooled PCs aimed at enthusiasts. The new Liquid PC systems are available in Z170 and X99 flavours, with the PC Specialist website offering lots of flexibility when speccing up your rig, including your choice of Mayhems coolant colour and lighting preferences.

You can choose from four tiers of water-cooling gear, with the entry-level selection buying you a 240mm radiator, tube reservoir, pump and CPU waterblock, while the next levels are capable of GPU cooling and add incrementally more water-cooling gear into the mix. Prices start at £1,291 inc VAT for a water-cooled Core i5-6600K with a GeForce GTX 970 graphics card. See **http://tinyurl.com/LiquidPC** for more information.

Razer unleashes ManO'War

Razer has just announced a new premium gaming headset, designed to offer superior wireless performance, thanks to multiple antennae, frequency channel scanning and an 'advanced coding algorithm'. According to Razer, the ManO'War's compact wireless USB adaptor provides a plug and play connection up to 12m away, which the optional extension dock can increase to 14m. The ManO'War also supports 7.1 virtual surround sound, and Razer's Chroma software gives you the full range of 16.8 million colours for creating a custom lighting scheme. The ManO'War is available to pre-order from **www.scan.co.uk** for £155 inc VAT.

Reviews

Our in-depth analysis of the latest PC hardware

Reviewed this month

HOW WE TEST
PAGE 34

GAMING MOUSE

Xtrfy XG-M2-NiP / £50 inc VAT

SUPPLIER www.overclockers.co.uk

Many mouse manufacturers are currently locked in a feature race, adding more buttons, RGB lighting, higher resolutions and software-enhanced macro support to their mice. But a few companies, such as Zowie, SteelSeries and Swedish firm Xtrfy, are doubling down on quality. The latter's XG-M2-NiP demonstrates this quality in a number of ways. Firstly, there are the materials. The soft-touch rubberised coating is very pleasant to hold, and the textured sides prevent the mouse body from being too slippery too. You also get a big pair of Teflon feet to keep gliding as smooth as possible, and the braided cable is fixed with a solid anchoring point.

It isn't an ergonomically moulded rodent, but that doesn't prevent it from being comfortable to hold. It has an ambidextrous shape that works pretty well in both claw and palm grips. That said, there's only one set of thumb buttons, so the XG-M2-NiP is really only designed for right-handed gamers. Lefties may get on with it, but the protruding buttons might become annoying, especially as they wouldn't really be usable. The XG-M2-NiP's weight of 112g is hefty for its low profile as well, but it isn't excessive, and we found it enhanced our sense of control.

The Omron switches provide precise and crisp feedback

The sensor is also high quality. We found the optical PixArt PMW 3310 (the same as the Avago ADNS-3310) to be essentially flawless, and it's well regarded as one of the best current sensors. Regardless of the resolution, we found it had no acceleration, no prediction and very little jitter – just smooth, consistent 1:1 tracking. It also has a low lift-off distance, with the mouse no longer tracking when we placed two optical discs between it and the surface.

You can toggle the resolution on the fly between five fixed levels – 400, 800, 1,600, 3,200 and 4,000dpi – and the DPI toggle buttons light up different colours to reflect the setting. On-the-fly adjustment is a feature that Zowie's FK2 mouse lacks, and it's definitely useful here. That said, the buttons should be further forward. You can't customise the DPI levels, but 400dpi should be low enough for any use and similarly, 4,000dpi is plenty.

You can also switch the polling rate, although not on the fly. Instead, a switch on the underside offers 125Hz, 500Hz and 1,000Hz settings. Along with the resolution toggling, this is the limit of the XG-M2-NiP's customisation, as it's fully plug and play. While you can't assign macros or shortcuts to its keys, we suspect the majority of users have little need for this ability anyway, and either way, there's an elegance in the simplicity. This mouse's name may not be easy to say, but it's definitely easy to use.

Omron switches continue the high-quality trend, giving the two main switches precise and crisp feedback. The scroll wheel nails it too – it feels great when clicking and scrolling, and it's housed securely. Lastly, the slightly textured, separated thumb buttons are large enough and offer a light, clean action too. As the NiP edition, this mouse carries the logo of Ninjas in Pyjamas, an eSports team. The NiP version only costs £3 more than the standard one, though, and the logo, scroll wheel and side strip all light up yellow.

Conclusion

Almost every element of this mouse is excellent, but £50 is still a lot for what it offers feature-wise. However, if you just want a solid, five-button mouse with on-the-fly sensitivity control and flawless tracking, which is certainly enough for many gamers, it just about justifies its cost through sheer quality.

MATTHEW LAMBERT

/SPECIFICATIONS

Connection Wired, USB
Sensor Optical
Resolution 4,000dpi
Cable Braided
Material Plastic
Extras None

DESIGN 38/40
FEATURES 23/35
VALUE 19/25

OVERALL SCORE 80%

VERDICT

Pricey, but the quality is superb. If a simple, great-quality, well-designed plug-and-play mouse is more important to you than a big feature set, then it justifies its cost.

Z170 MINI-ITX MOTHERBOARD

Gigabyte Z170N-Gaming 5 / £131 inc VAT

SUPPLIER www.scan.co.uk

Gigabyte already has a Z170 mini-ITX motherboard out, but its new Z170N-Gaming 5 sports a better cooling arrangement, with a heatpipe and beefed-up audio software suite. Aesthetically, it looks much better than Gigabyte's cheaper GA-Z170N-WiFi too. The Z170N-Gaming 5 has a distinct red, black and silver colour scheme and includes a metal-plated 16x PCI-E slot. The cheaper board still has the same five-phase power circuitry as the Z170N-Gaming 5, but lacks any VRM cooling, which will almost certainly hamper overclocking.

Otherwise, there's little difference between the two boards, except the Z170N-Gaming 5 sports a USB 3.1 (gen 2) Type-A port and a Type-C reversible port, while the cheaper board offers two Intel Gigabit Ethernet ports compared with the Z170N-Gaming 5's single Killer E2201 port. Both boards offer 802.11ac Wi-Fi, with a desktop aerial included, a 4x PCI-E 3 M.2 port on the rear of the PCB and six SATA 6Gbps connectors, with two snazzy chrome SATA cables in the box too.

We hit our maximum overclock using just the software

Two of these SATA ports are located rather awkwardly between the 16x PCI-E slot and DIMM slots, which could make cable tidying a little awkward, but there are four additional ones located among the two SATA Express connectors to the right of the DIMM slots. We can't complain too much here, though, as MSI's equivalent, the Z170i Gaming Pro AC, has the ports in a similar place and only offers four in total, while the Asus Maximus VIII Impact has all of its four SATA 6Gbps ports in this location.

A more significant hindrance to cable tidying is the location of the USB 3 header, which would usually found at the edge of the PCB, where it's positioned on both of the aforementioned boards, but the Z170N-Gaming 5 places it practically next to the rear I/O ports. The layout of mini-ITX cases varies hugely, so this design may or may not result in a problem, but it's worth remembering if you're planning to do some serious cable tidying. Thankfully, all the other major headers are located at the edge of the PCB, including the front panel header.

You might expect to see power and reset buttons, or other overclocking tools, on an ATX board at this price, but miniaturisation means there's a small premium to be paid, so they're absent on this board. Again, though, the MSI Z170i Gaming Pro AC lacks all these features except a clear-CMOS button, as does Asus' similarly priced Z170i Pro Gaming. On the plus side, Gigabyte claims the Realtek ALC 1150 audio system has shielded circuitry, plus a built-in rear audio amplifier and Creative's Sound Blaster X-Fi MB3 suite, which allows you to apply many of Creative's sound effects such as EAX, Crystallizer and smart volume.

While Gigabyte's EFIs may not be up to MSI or Asus' standards at the moment, lacking the clarity, attractiveness and easy navigation of its closest rivals, the Z170N-Gaming 5's Easy Tune software suite is excellent. In fact, we were able to hit our maximum overclock using nothing but the software. It includes dedicated pages for CPU and memory overclocking, and there's also a section for power options such as loadline calibration. Best of all, you can save profiles, so it's easy to call up benchmarking settings and then quickly revert to low power or gaming modes.

With MSI's board struggling to get above 4.7GHz, we started at this frequency when overclocking the Gigabyte, setting the vcore to 1.4V. These settings proved perfectly stable, so we notched up the multiplier to hit 4.8GHz, where our test system was still stable until we hit the RealBench Handbrake video encoding test, which kept failing until we raised the vcore further to 1.43V. This voltage is much higher than the vcore the Asus Z170i Pro Gaming needed to achieve the same frequency, but it's a better result than the MSI board, which couldn't manage 4.8GHz at all.

Performance

We were a little disappointed with the audio performance, at -99dBA for the noise level, 99dBA for the dynamic range and slightly more impressive 0.0044 for the total harmonic distortion according to RightMark Audio Analyzer, especially as Gigabyte boards usually excel in these tests. These results are some way off the -105.1dBA and 104.9dBA results we've seen from Gigabyte's ATX boards.

Performance in our RealBench tests was a little slow too, mainly due to mediocre results in the image editing and multi-tasking tests, but overall, its score of 130,482 at stock speed ended up being faster than Asus' Maximus VIII

/SPECIFICATIONS

Chipset Intel Z170

CPU socket Intel LGA1151

Memory support 4 slots: max 64GB DDR3 (up to 3600MHz)

Expansion slots Three 16x PCI-E 3, four 1x PCI-E 3

Sound Realtek ALC1150

Networking Killer E2201 Gigabit LAN, 802.11ac Wi-Fi

Overclocking Base clock 80–500MHz, CPU multiplier 8–120x; max voltages, CPU 1.5V, RAM 2V

Ports 6 x SATA 6Gbps (Z170), 1 x M.2, 1 x USB 3.1 Type-A, 1 x USB 3.1 Type-C, 5 x USB 3, 2 x USB 2, 1 x LAN, 8-channel surround audio out, line in, mic, optical S/PDIF out, 1 x HDMI 1.4, 1 x DVI

Dimensions (mm) 170 x 170

Impact. Its power consumption results of 41W at idle and 115W under load were excellent, although there were no issues to report in the SATA 6Gbps and M.2 speed tests either, hitting near maximum results of 556MB/sec read and 531MB/sec write for SATA, and 2,293MB/sec read and 960MB/sec write when using the M.2 port with a Samsung 950 Pro.

Once overclocked to 4.8GHz, the system score rose from 130,482 to 148,061, bettering the Asus Z170i Pro Gaming, but falling short of the Maximus VIII Impact and, of course, opening up a significant margin on the MSI board due to its 100MHz deficit. Power consumption remained frugal, though, despite the extra voltage, with the Gigabyte achieving the lowest idle result and second lowest load result.

1. **Unlike Gigabyte's previous Z170 mini-ITX board, the Gaming 5 has VRM cooling**
2. **The 16x PCI-E 3 graphics slot is metal-plated**
3. **802.11ac Wi-Fi is supported, with a desktop aerial included in the box**

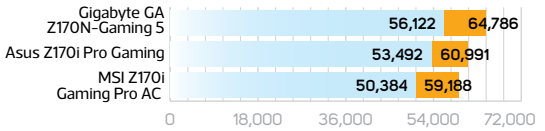
Conclusion

Competition is particularly fierce in the sub-£170 mini-ITX motherboard sector, and Asus' Z170i Pro Gaming is still our favourite all-rounder, as it costs just £125 yet offers everything except USB 3.1 Type-C support, and boasts a better EFI and slightly better audio than the Z170N-Gaming 5. Unless you think you'll need USB 3.1 Type-C during your system's lifetime, we'd suggest going for the Asus board. However, with its great looks, low power consumption, big bank of SATA ports and better cooling than most of its rivals, plus excellent overclocking software, the Gigabyte Z170N-Gaming 5 is still a fine motherboard if you prefer its looks to those of the Asus Z170i Pro Gaming.

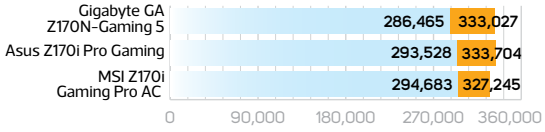
ANTONY LEATHER

CPC REALBENCH 2015

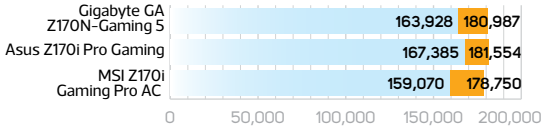
GIMP IMAGE EDITING



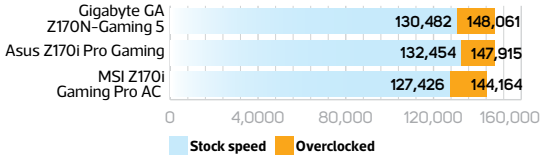
HANDBRAKE H.264 VIDEO ENCODING



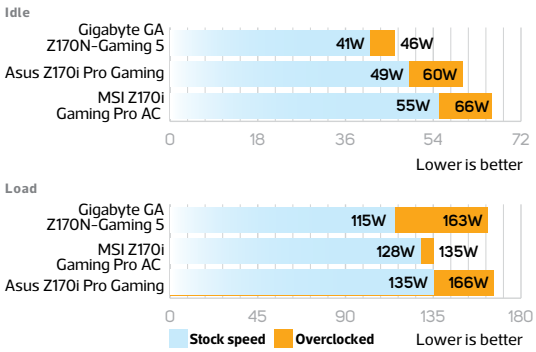
HEAVY MULTI-TASKING



SYSTEM SCORE

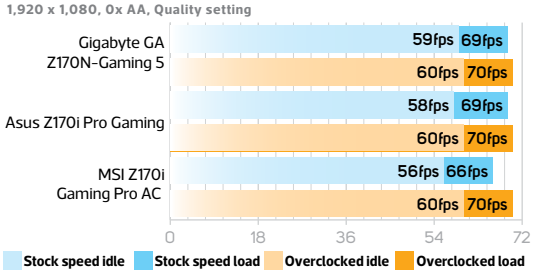


TOTAL SYSTEM POWER CONSUMPTION



TOTAL WAR: ATTILA

1,920 x 1,080, 0x AA, Quality setting



PERFORMANCE 35/40 | **FEATURES** 22/30

VALUE 25/30

OVERALL SCORE 82%

VERDICT

The Z170N-Gaming 5 looks great and offers the latest USB 3.1 features, although the Asus Z170i Pro Gaming is a better all-rounder.

/TEST KIT

4GHz Intel Core i7-6700K, 16GB Corsair Vengeance LPX 2666MHz DDR4 memory, 256GB OCZ Arc 100 SSD, Corsair HX860i PSU, Windows 10 Home 64-bit

ROTARY TOOL

Dremel Micro 8050-35 / £105 inc VAT

SUPPLIER www.dremel-direct.com / MODEL NUMBER F0138050JF

There are dozens of rotary tools on the market now, and Dremel makes a great deal of them. You might think you only need to sell one type of mini drill, but Dremel has proved there's a need for several different types, from hefty high-power models to small, light engraving-focused ones. The Micro 8050 aims to fill a niche that could be very popular for modders – it isn't just cordless, but it's also much smaller and lighter than your average mains-powered Dremel.

It's perhaps even pocketable, measuring less than 5cm wide and 20cm long. That said, it still weighs 250g, and while that's half the weight of Dremel's popular corded 3000 tools, it's still a little too heavy for delicate tasks such as engraving if you don't have burly hands, at least for long periods of use. Unfortunately, its design also means that you can't use Dremel's flexible shaft attachment, which is a shame, as this attachment turns its other tools into highly delicate, light instruments, and not just for engraving either.

It sports a ring of bright LEDs to illuminate what you're cutting

Instead, where other Dremel rotary tools have a detachable collar, the Micro 8050 sports a ring of bright LEDs to illuminate whatever you're cutting. This feature is particularly useful for working inside objects such as PC cases, where you don't have a spot lamp to shine some light on the scene. Otherwise, though, the Micro 8050 uses a standard 3.2mm collet and collet nut, so you can use any of Dremel's standard attachments.

Our particular sample came with 35 accessories, including several types of cutting disc, sanding wheels, polishing pads, a grinding stone and two engraving tips, all packed into a small plastic storage box. The kit also includes a compact case and small desktop charger, which powers off when the battery is fully charged. The battery is sealed inside the unit and is rated at 1,000mAh. Dremel states a charge time of just under four hours, but the battery's lifespan depends on the task – engraving, sanding and low-speed tasks will likely see several hours of use at least, but ramping up the speed and dealing with steel panels using one of the cutting discs will drain it much quicker. Still, most Dremel tasks take less than 30 minutes, so the battery should be fine for most jobs.

Thankfully, there's also a battery charge indicator that gives some warning if you need to give it some juice, with a rotation speed meter above it. The latter has five settings from 5,000 rpm to 28,000rpm, which is a wide enough range to cope with practically any task. The Micro 8050-35 has a surprising amount of torque too, and is more than capable of chewing through steel using its reinforced cutting discs and high speed settings.

/SPECIFICATIONS

Power Cordless battery
Speed 5,000-28,000rpm
Weight 250g
Accessories Cutting discs, grinding stone, engraving tips, sanding wheels, buffing pads, bristle brush, charger, carry case

Conclusion

For the same money as the Micro 8050, you could buy a Dremel 4000 kit that includes similar accessories, plus Dremel's flexible shaft and routeing attachments. The Dremel 4000 is also more powerful and flexible, but larger and heavier – either way, for regular, intensive use it's a better buy. Where the Micro 8050's excels, though, is in its ease of use, light weight and portability, which makes it perfect for an occasional-use tool that can work away from power points and takes up very little space.

ANTONY LEATHER

PERFORMANCE	FEATURES	VALUE
31/35	29/35	25/30

OVERALL SCORE **85%**

VERDICT

If you want a lightweight, portable Dremel, the Micro 8050 is a great choice, but a corded 4000-series tool offers more for your money.

ELITE NEW ENTRY P64

GAMING KEYBOARD

Corsair Gaming K70 RGB Rapidfire / £149 inc VAT

CUSTOM PC PREMIUM GRADE

SUPPLIER www.scan.co.uk

The original K70 had several advantages over Corsair's recent Strafe keyboards, such as an aluminium fascia, dedicated media controls, including a volume roller, and braided cables. This super-premium keyboard, which has won plenty of awards in the past, is now back and called the K70 RGB Rapidfire.

All the K70's previous features return, including the full set of dedicated media controls and volume roller – a rare, but useful feature that's absent from most keyboards. The USB pass-through, which was omitted from the K70 RGB and is useful for connecting headsets and mice, is back too. You'll need two free USB ports to make use of it, though, via the 2m braided cable that splits in two at the end.

Cherry's new MX Speed switches have a 1.2mm actuation distance

You get a wrist rest too, although it isn't as substantial as some we've seen, such as the rest with Gigabyte's Aivia Osmium. The build quality is excellent and the keyboard's brushed black aluminium fascia looks much more elegant than the plastic of its Strafe siblings. The spacebar sports a textured finish, and there are replacement textured key groups catering for FPS and MOBA gamers. As you'd expect, given its name, the K70 RGB Rapidfire also offers full, per-key RGB backlighting, which has been improved since its predecessor and the keys sport a new bolder font that allows more light to shine through them – the lighting is noticeably more vivid as a result.

The biggest change to previous K70s, though, is the introduction of Cherry's new MX Speed switches. Exclusive to Corsair for the next six months, they're essentially Red switches with a 1.2mm actuation distance, as opposed to the Reds' 2mm actuation distance. The response time is improved, although the impact is slight in action. Otherwise, the switch has the same 45nm actuation force and light-feeling, non-clicky movement of the Cherry MX Red switch.

Meanwhile, Corsair's CUE software suite enables you to reassign every key, record and execute macros, including mouse input, and create custom keystrokes and additional profiles. The in-depth macro function is handy, as the keyboard otherwise has no macro features at all.

The lighting effects occupy a large chunk of the software. As well as the ability to sync effects across other Corsair RGB peripherals, there's a number of pre-configured fancy effects. You can also create your own effects, simply apply different colours to single keys (or groups of keys) and even download some mind-bogglingly complicated effects that other users have created via Corsair's website. The only missing lighting feature is the ability to set different sections at different brightness levels.

Conclusion

It's great to see the return of the K70 in the form of the RGB Rapidfire, and while the super-fast switches may not offer a huge improvement for most people, the new model sports a number of extra features, such as a USB pass-through and improved lighting. Cooler Master's MasterKeys Pro L – the large version of our recent keyboard Labs winner - is cheaper and also sports good software and RGB lighting, but it doesn't match the K70's excellent build quality and aluminium faceplate. The K70 RGB Rapidfire might be expensive, but it comes highly recommended if you have this much cash to drop on a keyboard.

ANTONY LEATHER

/SPECIFICATIONS

Connection Wired, USB
Cable 2m, braided
Material Aluminium, plastic
Switch type Cherry MX Speed
Backlighting RGB
Extras USB pass-through, wrist rest, additional textured keys

DESIGN 37/40
FEATURES 32/35
VALUE 17/25

OVERALL SCORE 86%

VERDICT

The new K70 isn't cheap, but its supreme build quality, media controls, and improved lighting and features make it an excellent premium keyboard if you have the cash.

Z170 ATX MOTHERBOARD

Asus Maximus VIII Hero Alpha / £236 inc VAT

SUPPLIER www.overclockers.co.uk / **MODEL NUMBER** 90MB0P50-M0EAY0

With Skylake launching last summer, there's now a considerable number of options when it comes to choosing a Z170 motherboard. Even above the £200 mark, you'll find plenty of great examples, from MSI's Xpower Titanium to Asus' Maximus VIII Formula. However, we were a little confused when Asus announced a new version of its Maximus VIII Hero earlier this year. The original board was already very good, if a little pricey. With the new Hero Alpha set to retail at £230 inc VAT, it certainly raised a few eyebrows.

The first reason for the new launch is the price. The Formula costs close to £300, while the Hero stands at less than £200, meaning you don't have many options north of £150 if you want an ATX ROG board. Secondly, the Formula has a number of features the Hero lacks, such as U.2 ports, RGB LED strip headers and an RGB controller, plus Intel-controlled USB 3.1 Type-A and Type-C ports. The Hero Alpha, however, includes all these features and even adds a second U.2 port and RGB LED strip header port, while the Formula has just one of each.

You get a dedicated pump header for all-in-one liquid coolers

Clearly, U.2 is fairly niche and Intel's SSDs that are compatible with the new storage connector are very slim on the ground, not to mention expensive. They aren't particularly good value compared with the likes of Samsung's super-fast 950 Pro M.2 SSD either, although they're available in higher capacities. The RGB headers are very useful if you want to add some lighting to your PC though. They're compatible with most 4-pin RGB LED strips and Asus included two strips from CableMod with our Hero Alpha sample. They're simple to connect and you can use extension cables to place them anywhere in your case. Of course, the main benefit is the ability to dispense with a separate controller such as NZXT's Hue+, which will set you back around £50, although it does include LED strips.

The Intel-controlled USB 3.1 ports are another addition focused on high-end users. The previous model used ASMedia-controlled ports that would likely function just as well, but lacked Thunderbolt 3 support, which the Hero Alpha now offers. The downside is that, while it has more potent USB 3.1 ports, it only has two USB 3 ports and two USB 2 ports on the rear I/O panel. Even if you use the Type-A USB 3.1 (gen 2) port, that's only five Type-A ports in total, which may leave you short if you have several older USB devices. Another addition compared with the standard Hero is 802.11ac Wi-Fi, with a pair of antennas included in the box as well.

So there are a number of extra features compared with the standard Hero, but the layout and aesthetics are practically identical. The main change is the lack of a proper on-board reset button (there are still power and clear-CMOS buttons, as well as an LED POST code display). There are trios of 16x and 1x PCI-E slots, with the top 1x slot located above the primary 16x slot, so you'll have one slot free even if you install several graphics cards. Meanwhile, the M.2 port is located at the base of the PCB so, unless you're opting for a two-way graphics card setup, accessing it shouldn't be an issue. The only slight fly in the ointment is that both the primary 16x PCI-E slots are located so that long graphics cards will make accessing the SATA and U.2 ports difficult.

There's a generous helping of fan headers and, as with most current premium Asus motherboards, you get a dedicated pump header for all-in-one liquid coolers, so you won't have to worry about the board's fan controller accidentally limiting the voltage to the pump. As with the original Hero, the ROG logo on the PCH heatsink is lit by an RGB LED; as well as the RGB 4-pin headers, this is controlled in Asus' Aura software. You can tweak each LED independently, apply lighting effects or just select one colour from the full RGB spectrum. There's also the ability to synchronise lighting effects across all three lights.

Asus' ROG motherboards are always equipped with a vast amount of software features too. In addition to the Aura lighting program, you get AI Suite, which includes numerous applications, including excellent Windows-based tweaking programs that enable you to control fan speeds and perform real-time overclocking, without the need to reboot and head into the EFI.

/SPECIFICATIONS

Chipset Intel Z170

CPU socket Intel LGA1151

Memory support 4 slots: max 64GB DDR3 (up to 3600MHz)

Expansion slots Three 16x PCI-E 3, four 1x PCI-E 3

Sound Realtek ALC1150

Networking Intel I219-V Gigabit Ethernet, 802.11ac Wi-Fi

Overclocking Base clock 40– 650MHz, CPU multiplier 8-83x; max voltages, CPU 1.7V, RAM 2V

Ports 4 x SATA 6Gbps (Z170), 2 x SATA 6Gbps (ASMedia), 1 x M.2, 2 x U.2 1 x USB 3.1 Type-A, 1 x USB 3.1 Type-C, 2 x USB 3, 2 x USB 2, 1 x LAN, 8-channel surround audio out, line in, mic, optical S/PDIF out, 1 x HDMI 1.4, 1 x DisplayPort

Dimensions (mm) 305 x 244

1. Two headers for RGB LED strips sit at the bottom of the board
2. A pair of U.2 ports sits next to the SATA ports, for use with the latest Intel SSDs
3. An M.2 SSD socket is positioned between the bottom two 16x PCI-E slots

Performance

At stock speed, the Hero Alpha's RealBench system score of 132,460 was comparatively middle of the road, and overclocking the CPU to 4.8GHz using a vcore of 1.33V returned a similarly middling result of 149,464, although these results aren't miles behind most other results overall – the Alpha's performance is still fine. There were no issues in the storage benchmarks though, with the Alpha performing the same in the SATA 6Gbps and M.2 port results as the rest of the pack, taking full advantage of Samsung's 950 Pro M.2 SSD with read and write speeds of 2,295MB/sec and 960MB/sec respectively. The on-board audio was practically identical to that of the original Hero and most other premium Realtek-based motherboards according to RightMark's Audio Analyser software too.

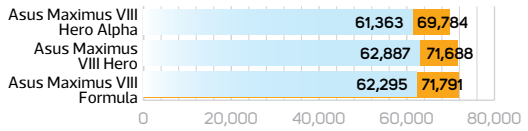
Conclusion

The Hero Alpha is much cheaper than the Maximus VII Formula than the latter, but sports many of the same luxury features, while offering a better specification than the standard Hero. Whether these extras are worth the money will largely depend on your desire for RGB lighting, U.2 storage and Thunderbolt 3 support. If none of these features appeals to you, the standard Hero is the better option, but if you have a sub-£250 budget and want to build a super high-end system with some lighting pizzazz, the Hero covers the bases well.

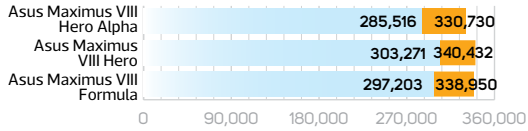
ANTONY LEATHER

CPC REALBENCH 2015

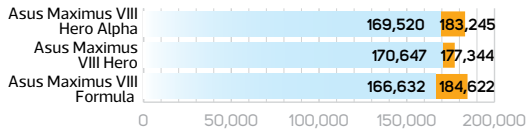
GIMP IMAGE EDITING



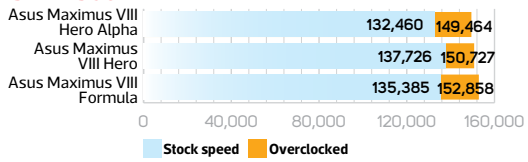
HANDBRAKE H.264 VIDEO ENCODING



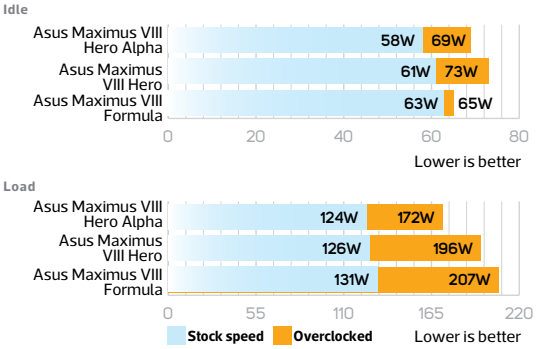
HEAVY MULTI-TASKING



SYSTEM SCORE

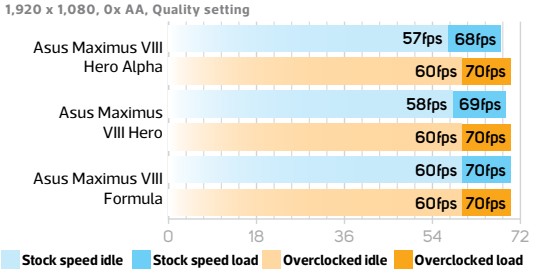


TOTAL SYSTEM POWER CONSUMPTION



TOTAL WAR: ATTILA

1,920 x 1,080, 0x AA, Quality setting



PERFORMANCE 25/30 | FEATURES 32/35

VALUE 28/35

OVERALL SCORE 85%

VERDICT

The Alpha brings flexible RGB lighting control to the Hero, while costing much less than the Formula – great for adding aesthetic pizzazz to a high-end system.

/TEST KIT

4GHz Intel Core i7-6700K, 16GB Corsair Vengeance LPX 2666MHz DDR4 memory, 256GB OCZ Arc 100 SSD, Corsair HX860i PSU, Windows 10 Home 64-bit

PC Specialist recommends Windows Windows 10

Performance without compromise

Spectre Lite

- AMD FX-4300
- ASUS® M5A97 R2.0
- 8GB HyperX FURY RAM
- 2GB NVIDIA® GeForce® GTX 950
- 1TB Hard Drive
- Corsair 350W PSU
- **Windows 10**
- 3 Year Standard Warranty

THIS SPEC FROM £499*

Gladius 900

- Intel® Core™ i5-6600K
- ASUS® Maximus VIII Hero
- 8GB HyperX FURY RAM
- 2GB NVIDIA® GeForce® GTX 960
- 1TB Hard Drive
- Corsair 450W PSU
- **Windows 10**
- 3 Year Standard Warranty

THIS SPEC FROM £899*

Vitrum

- Intel® Core™ i5-6600K
- ASUS® Z170-E
- 16GB HyperX FURY RAM
- 4GB NVIDIA® GeForce® GTX 970
- 400GB Intel® 750 PCIe SSD
- 1TB Hard Drive
- **Windows 10**
- 3 Years Warranty

THIS SPEC FROM £1,199*

Glacier

- OC Intel® Core™ i7-6700K
- ASUS® Maximus VIII Hero
- 16GB Corsair Vengeance RAM
- 6GB NVIDIA® GeForce™ GTX980Ti
- 400GB Intel® 750 PCIe SSD
- 2TB Hard Drive
- **Windows 10**
- 3 Years Warranty

THIS SPEC FROM £1,799*

14" Enigma VI

- Intel® Core™ M CPUs
- Intel Integrate Graphics
- Ultra thin: Just 15.6mm!
- Full HD IPS Screen
- Up to 7.5 Hours Battery
- Wireless as standard
- **Windows 10**
- 3 Year Standard Warranty

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15.6" Octane II

- 6th Gen Intel® Core™ CPUs
- NVIDIA® GeForce™ Graphics
- NVIDIA® G-SYNC™ Option
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- Thunderbolt™ 3
- Wireless as standard
- **Windows 10**
- 3 Year Standard Warranty

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* Prices are including VAT and are correct at the time of printing, but subject to change.

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- 4GB NVIDIA® GeForce® GTX 980
- 500GB Samsung EVO 850 SSD
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ATX CASE

In Win 909 / £330 inc VAT

SUPPLIER www.scan.co.uk

If we told you five years ago that In Win would be making some of the most desirable, premium PC cases on the market, you probably wouldn't have believed us. However, the company's turnaround is now complete, with the likes of the 901 and 805 among our favourite cases. Best of all, they don't cost a fortune either, despite some of the company's initial outlandish efforts being wallet killers. The latest addition is the 909 – an enormous sibling to the 901 and 904.

It looks very similar to those cases, with a single piece of aluminium wrapping around the entire outer edge before rejoining at the rear. Such a design makes any case expensive and, just as the 901 was a fairly pricey mini-ITX case, at £330, the 909 is one of the most expensive ATX cases we've reviewed too. You do get a heck of a lot for your money though. For starters, that gorgeous brushed aluminium exterior, which comes in silver or black, is sandwiched between two huge, darkened tempered glass side panels.

A single piece of aluminium wraps around the entire outer edge

As with its smaller siblings, these panels are held in place with inconspicuous thumbscrews. They're proprietary parts, but In Win has thoughtfully included a couple of extra thumbscrews in the box should you lose any of them. The panels make up the whole of the side sections, so all your hardware is on display, although this view does mean you'll need to pay extra attention to cable tidying. The 909 is one of the first cases we've seen to include a USB 3.1 Type-C port too; however, as it connects to a USB 3 header, you won't be able to tap into all of the benefits of the new USB standard. This port is located on a panel at the bottom of the left side panel, which could be tricky to use on a regular basis if you intend to have the case situated on the floor. However, you get three USB 3 ports, a power button and the usual audio jacks too.

The rear of the 909 looks quite odd too, for the simple reason that there's a huge gap between the motherboard's location and the end of the case. This space makes up for the fact there's no way to mount a radiator in the roof, and the front section is far from ideal for radiator mounting too, as there are no vents. In Win has basically extended the shell of the case backwards to make room for a radiator in this location, and space is ample with plenty of room for a 60mm-thick radiator and a row of fans. This setup means that you have to feed the cables from the graphics card and motherboard through the rear of the case though.

Up to a triple 120mm-fan or double 140mm-fan radiator can be mounted in this location, with space for a 120mm-fan radiator internally next to the motherboard, a double 120mm-fan radiator above the front panel ports and a double 120/140mm-fan radiator in the front of the case. Fundamentally, this design prevents the need to cut up that sweeping aluminium shell, and while the case is huge as a result, In Win hasn't compromised too much, and there's plenty of room for mounting pumps and reservoirs internally too. Despite the high price tag, the 909 doesn't ship with any fans, although if you're spending this much money on a case, you'd most likely be splashing out on a full water-cooling system and premium fans anyway.

There's a mass of storage options too, including six dedicated SSD mounts behind the motherboard and a further four dual-purpose 2.5in/3.5in mounts at the top of the case in tool-free bays. Meanwhile, the PSU sits under a shroud with its fan pointing into the case, so there's no need for a dust filter here. In fact, the only filter is in the dual fan mount above the front panel ports, which is the main intake vent. Due to its size, In Win has also included 8-pin CPU and 24-pin ATX power extension cables, as well as a cloth to wipe fingerprints off the side panels.

The 909 isn't perfect though. Build quality isn't quite as stellar as you'd expect for the price – some of the edges are a little sharp, and the drive bays and fan mounts are a bit thin and basic for the price, plus screwing them into place can be awkward, as some of the screwholes can be tricky to line up. Overall, we have no major complaints with the design and quality though.

Performance

We first tested the case in its out-of-the-box configuration with no fans and, not surprisingly, the interior became very toasty, with the CPU throttling after 14 minutes. Needless to say, you need to add fans to this case to get the hot air out of it, especially as there are two rear panels fighting against the airflow. Adding two standard 1,000rpm, 120mm fans – one at the front and another in the first rear section next to the motherboard – saw the CPU temperature drop by 14°C and the GPU temperature by 10°C.

/SPECIFICATIONS

Dimensions (mm) 231 x 575 x 540 (W x D x H)

Material Aluminium, glass

Available colours Black, silver

Weight 17kg

Front panel Power, 3 x USB 3, 1 x USB 3.1 Type-C, stereo, mic

Drive bays 6 x 2.5in, 4 x 3.5in/2.5in

Form factor(s) ATX, E-ATX, Micro-ATX

Cooling 2 x 120mm/140mm front fan mounts (fans not included), 1 x 120mm mid fan mounts (fans not included), 3 x 120mm/2 x 140mm rear fan mount (fans not included), 2 x 120/140mm bottom fan mounts (fans not included)

CPU cooler clearance 175mm

Maximum graphics card length 320mm

HOW WE TEST
PAGE 34

1. A large gap at the back provides loads of room for water-cooling gear
2. There's a USB 3.1 Type-C port, but it can only hook up to a USB 3 header
3. Four dual-purpose 2.5in/3.5in mounts sit at the top in tool-free bays

These results point at reasonable CPU cooling, but the GPU cooling is actually pretty good, probably due to the fact there's a large vent nearby.

We can't read too much into these results as a basis for the 909's cooling score though. This case is designed to be packed full of water-cooling gear, or at the very least, a bunch of 120mm and 140mm fans, and a massive CPU cooler; as our testing showed, adding just two fans to the equation improved airflow massively.

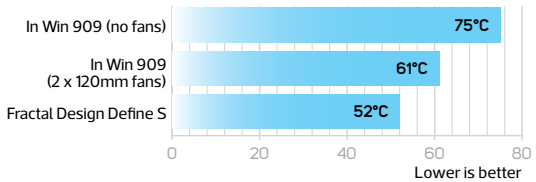
Conclusion

The In Win 909 is a towering mass of glass and aluminium, and it looks every bit like it's worth its high asking price, much like the 904 and 901 before it. There's space inside the 909 for a monstrous water-cooled system, but unlike cases from the usual suspects such as Corsair and Fractal Design, the 909 enables you to build a big, fancy water-cooled system in a very attractive case, rather than a massive, bland black box.

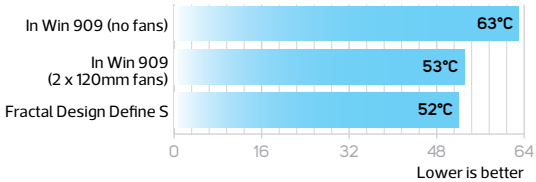
Build quality isn't quite what you'd expect for the money, and some build work can be fiddly, but the end result is a fantastic-looking case with loads of cooling potential. If great looks and space for water-cooling gear are your priorities then ATX cases don't get much better than the 909, but you pay a high price for it.

ANTONY LEATHER

CPU LOAD DELTA T



GPU LOAD DELTA T



COOLING	FEATURES
23/30	17/20
DESIGN	**VALUE**
27/30	13/20

OVERALL SCORE
80%

VERDICT

If you're splashing out on a high-end water-cooled PC then the 909 offers a unique and eye-catching design with room for loads of water-cooling gear, but it isn't cheap.

ELITE NEW ENTRY P64

NAS BOX

Synology DS216j / £131 inc VAT

SUPPLIER www.ebuyer.com

Synology's new DS216j makes a good first impression by costing £13 less than the launch price of the DS215j, and it upgrades some of the latter's specs too. The CPU has been changed from an 800MHz Marvell Armada 375 dual-core CPU to a 1GHz Armada 385, although the 512MB of DDR3 memory remains unchanged.

To cater for the latest hard disks, the base specification now supports up to 8TB drives as well – up from 6TB with the DS215j – bringing the total supported storage to 16TB, if you opt for a basic or JBOD RAID array. The two USB ports at the rear are now both of the USB 3 variety too – good for doing a quick backup to an external drive.

Not surprisingly, the stated power consumption has risen, albeit by less than 2W to just under 15W, although the noise level has apparently dropped a little to 18.2dBA. The 92mm fan is practically inaudible for the most part, and will likely be overshadowed by the noise your hard disks make anyway. Inside, the DS216j is practically identical to its predecessor with two anti-vibration 3.5in mounts.

The 92mm cooling fan is practically inaudible for the most part

Then there's the software. Synology's current operating system version is DSM 6, which improves various aspects of business-level and consumer-level features, as well as introducing 64-bit support. As a result, the Photo Station app can now handle home videos up to 32GB in size and can automatically watermark your photos, while Video Station has received a makeover too. However, one of DSM 6's key features – offline video transcoding – appears to be missing from the options with the DS216j, and seems to be reserved for more expensive models that offer live transcoding.

That's a shame, as the ability to use a NAS to pre-transcode video for mobile devices would be very useful and it's the first time we've really missed a significant feature on Synology's cheaper products, which usually offer software features similar to their pricier counterparts. However, it's a drop in the ocean as far as other features of DSM 6 are concerned, as you get the full spectrum of media streaming support, from iTunes, DLNA and Plex servers to Synology's own media streaming app, Video Station. There's the ability to create your own Dropbox-style cloud storage too, and of course, to share your media across the Internet.

We use Intel's NAS Performance Toolkit to test NAS enclosures, and the DS216j was faster across the board than the older DS215j, although the latter was using an older version of the operating system, as we tested it a while ago. It was much faster in the torturous photo album and directory copy tests, with speeds ranging from 12MB/sec in the photo test to 24MB/sec in the directory read rest, while the older NAS managed just 7.7MB/sec and 14MB/sec respectively. The maximum throughput we saw with the older DS215j was 93.2MB/sec compared to 115.6MB/sec for the DS216j.

Conclusion

Synology's enhanced transcoding support on its more expansive NAS enclosures, such as the DS216Play, has meant that its cheaper J-series models are suddenly a little lacking. Enhanced transcoding is just one feature that the DS216j lacks in a vast array of others, but it's significant if you regularly stream video to mobile devices. It's worth considering a more expensive Synology model if streaming video is top of your list, but for everyone else, the DS216j is a fast and worthy successor to the DS215j at a good price.

ANTONY LEATHER

SPEED 32/35

FEATURES 31/35

VALUE 24/30

OVERALL SCORE 87%

VERDICT

Synology's pricier boxes are better for video streaming, but the DS216j takes the general NAS crown, with fast performance and decent features for a good price.

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- Corsair DDR4 8 GB 2133 MHZ
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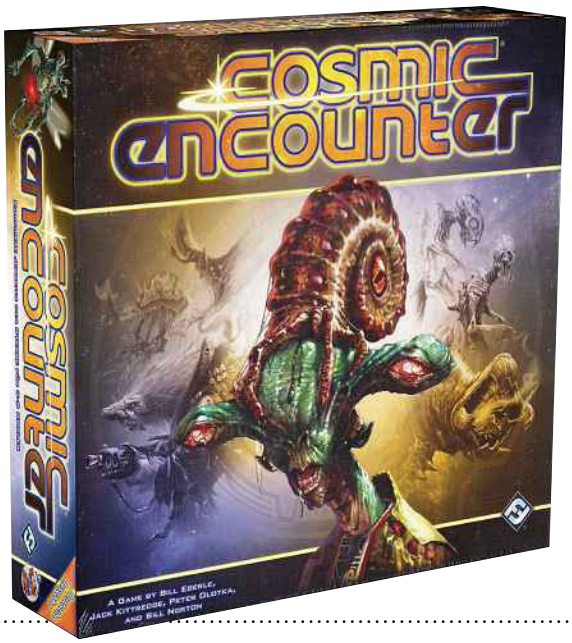
Paul Goodhead checks out the latest gadgets, gizmos and geek toys

BOARD GAME

Cosmic Encounter / £46 inc VAT



Galactic colonisation is the core objective of Cosmic Encounter, with players racing to set up colonies outside their starting system. These colonies can be founded via cosy, mutually beneficial alliances, or by raining down fire and brimstone on an unsuspecting planet until you receive compliance. It's your choice.

The real texture of the game appears in the alien races that you play, however. There are 50 different sides, each with unique rules, some of which wildly alter the core mechanics. Play with the full five players (which is best in our experience) and no two games will ever quite be the same. Add in the fact that alliance building (and breaking) is encouraged, and that part of a player's strength is hidden in their hand cards, and you end up with a delightfully variable game that's surprisingly easy to pick up.

●●●●○

SUPPLIER www.wordery.com

EXTERNAL BATTERY

TYLT Energi 12K / £57 inc VAT

For its size, the TYLT Energi 12K packs a wallop, with a 12,000mAh battery in a box that's only a little larger than a pack of cigarettes. Weighing 263g, it's still a significant weight to carry, however; you certainly notice when it's been added to a bag. Your reward for carrying this burden is impressive though. You can simultaneously charge devices connected to the three USB ports, meaning it can keep a whole family's worth of devices in the green without the need to form an orderly queue. Its large capacity makes it an ideal companion for long stints away – it charged our test Nexus 5X phone to full from empty just over three times before wilting. The one downside is that charging the unit itself from the USB connection takes a long time once you've run it dry.

●●●●○

SUPPLIER www.amazon.co.uk

MOBILE WI-FI HUB

TP-Link 3G Mobile WiFi M5360 / £50 inc VAT

Despite its bland appearance, there's plenty going on in the pocketable M5360. It can connect to the Internet via a 3G network and share this connection with up to ten devices via its 802.11n Wi-Fi router. It will also share the contents of an inserted SD card. A sharp, three-line LCD shows useful network information, and it's all powered by a capacious 5,200mAh battery, which you can also use to charge phone or tablet. It sounds like an ideal travel companion, but while 3G is now ubiquitous, it's slow. Far too slow, in fact, for feeding the Internet to ten devices. With data costs to consider, it can be expensive to run too.

●●●○○

SUPPLIER www.johnlewis.com

MOUSE MAT

Mionix Alioth (Medium) / £9 inc VAT

Last month we saw a pair of Mionix Sargas mouse mats, and while we liked them, they didn't feel quite as refined or as well made as the Alioth. That's due in large part to the latter's excellent fabric surface, which is stitched so finely and tightly that it's easy to initially mistake it for plastic. Compared with other fabric mats, the Alioth is relatively low friction, making for a more silky tracking experience.

The stitched edges are a welcome inclusion too, as they make the mat more robust and hard-wearing. It's quite thick for a fabric mat though – its 3mm depth makes it noticeably chunkier than other mats we've tested. We liked the squishy, luxurious feel that results from this thickness, but it may not be to everyone's tastes. If you're after a thick, high-quality fabric mouse mat, and like a bit of squishiness, however, the Alioth will suit you fine.

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SUPPLIER www.pcnation.co.uk

WI-FI AUDIO EXTENDER

D-Link Music Everywhere / £20 inc VAT

D-Link's Music Everywhere hooks into an existing Wi-Fi network and streams music to a speaker or hi-fi system from a phone, tablet or PC. It connects to speakers via a 3.5mm jack, providing a useful way to bring an old but still capable set of speakers into the 21st century. It does the job well, but you can achieve much the same result with a Bluetooth adaptor; unlike the Music Everywhere, this won't require a dedicated app to work – adding an extra layer of faffing. The Music Everywhere also acts as a Wi-Fi extender, but we found the signal strength pretty measly, making this feature a fringe benefit at best. We've seen better ways of setting your music free.

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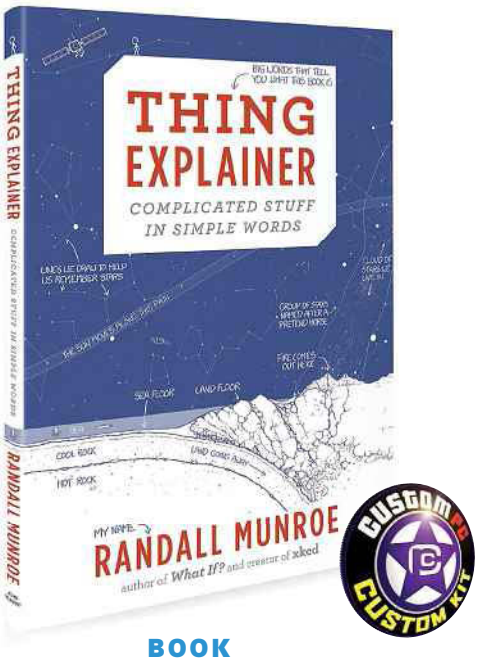

BOOK

Thing Explainer: Complicated Stuff in Simple Words / £6 inc VAT

Explaining complicated concepts simply isn't easy, but Randal Munroe (of XKCD fame) has nailed it. Limiting himself to the 1,000 most commonly used English words, Thing Explainer dissects and explains the workings of everything from a Saturn V rocket through to a laptop, all in an adorably whimsical child-like tone. A CPU becomes a 'thinking box' for example, while a plane becomes a 'sky boat'. All the explanations are accompanied by large exploded diagrams, each with a wealth of detail. It's ideal for kids into science, but many of our office's big kids also appreciated Munroe's subtle wit and beautiful illustrations.

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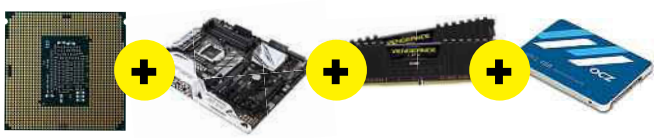
How we test

Thorough testing and research is the key to evaluating whether a product is worth buying, and deciding whether or not there's a better alternative

PROCESSORS

We judge CPUs on whether they offer sufficient speed for the price. Part of a CPU's speed score comes from how overclockable it is. Every type of CPU is tested in the same PC, so all results are directly comparable.

INTEL LGA1151



Intel LGA1151 CPU | Asus Z170 Deluxe (ASRock Z170 Extreme4 for Core i3 6100 test) | 16GB Corsair Vengeance LPX 2666MHz DDR4 | 240GB OCZ Arc 100

INTEL LGA2011-V3

Intel LGA2011-v3 CPU | Asus Rampage V Extreme | 16GB Corsair Vengeance LPX 2133MHz DDR4 | 512GB Crucial MX100

AMD FM2+

AMD FM2+ APU | MSI A88X-G45Gaming | 16GB Corsair Vengeance Pro 2133MHz DDR3 (GPU testing) | 8GB Corsair Vengeance Pro 1600MHz DDR3 (CPU testing) | 240GB Crucial M500

COMMON COMPONENTS

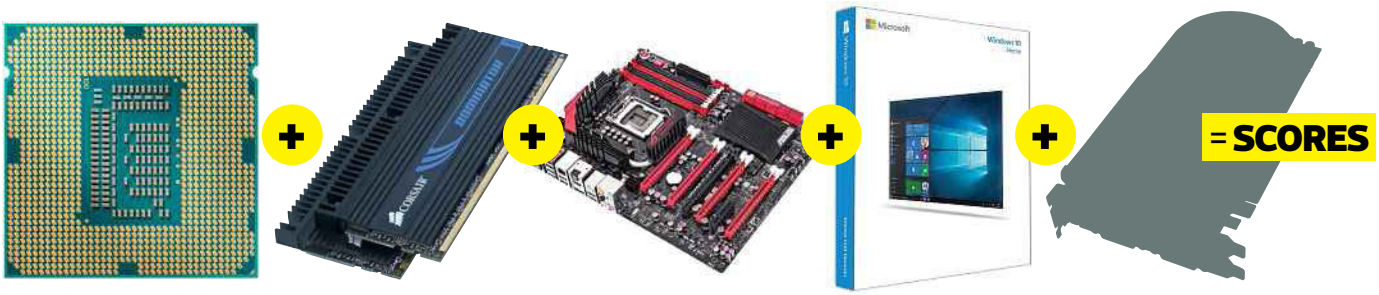
AMD Radeon R9 390X* | Windows 10 64-bit

TESTS: We use Custom PC RealBench 2015, Cinebench R11.5 and a variety of games. We also test the power draw of the test PC with the CPU installed. These tests reveal a broad range of performance characteristics, from image editing to gaming and video encoding to 3D rendering. We run all tests at stock speed and again when overclocked to its highest frequency.

*Please note: We test AMD FM2+ APUs using the on-board graphics, not the AMD Radeon R9 390X

GRAPHICS CARDS

Graphics cards are mainly evaluated on how fast they are for their price. However, we also consider the efficacy and quietness of the cooler. Every graphics card is tested in the same PC, so all results are directly comparable.



4.2GHz Intel Core i5-3570K | 8GB Corsair Dominator 2400MHz DDR3 | Asus Maximus V Extreme | Windows 10 64-bit | The graphics card we're reviewing

CUSTOM PC REALBENCH 2015

INTEL REFERENCE

Intel Core i7-4790K | 16GB of Corsair 2400MHz DDR3 | 240GB OCZ 150 | Asus Maximus Gene VII | Nvidia GeForce GTX 780 3GB = 100%

AMD REFERENCE

AMD A10-7850K | 8GB of Corsair 2133MHz DDR3 | 256GB Plextor M5 Pro | Asus A88X-Pro = 100%

Our benchmark suite, co-developed with Asus, simulates how people really use PCs – a higher score is better. You can download them from www.asus.com/campaign/Realbench

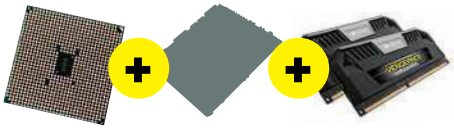
MOTHERBOARDS

Motherboards are evaluated on everything from layout and features to overclockability and value for money. Every motherboard is tested with the same components, so all results are directly comparable.

INTEL LGA1151

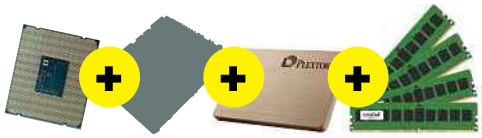
Intel Core i7-6700K | Motherboard on test | 16GB Corsair Vengeance LPX 2666MHz DDR4 | 240GB OCZ Arc 100

AMD FM2+



AMD A10-7870K | Motherboard on test | 16GB Corsair Vengeance Pro 2133MHz DDR3

INTEL LGA2011-V3



Intel Core i7-5960X | Motherboard on test | Plextor M6 256GB | 32GB Crucial 2133MHz DDR4

COMMON COMPONENTS

AMD Radeon R9 390X* | Windows 10 64-bit

TESTS: We use Custom PC RealBench 2015 and Total War: Attila, and also test the speeds of the board's SATA and M.2 ports. We try to overclock every motherboard we review by testing for a maximum QPI, base clock or HTT as well as overclocking the CPU to its maximum air-cooled level. We run our tests at stock speed and with the CPU overclocked.

*Please note: We test AMD FM2+ motherboards using the on-board graphics, not the AMD Radeon R9 390X

TESTS: By using the fast PC detailed on the left, we can be sure that any limitations are due to the graphics card on test, rather than being CPU limited. We test GTA V, Shadow of Mordor, Crysis 3, Fallout 4 and The Witcher III: Wild Hunt at their maximum detail settings, in their highest DirectX mode, at several resolutions. High-end cards should be able to sustain playable frame rates at 2,560 x 1,440, while 1,920 x 1,080 is more important for mid-range cards; we also test at 3,840 x 2,160 for 4K monitors, and try to overclock every graphics card we test to assess the performance impact.

The Awards

EXTREME ULTRA
Some products are gloriously over the top. These items of excellent overkill earn our Extreme Ultra award.

PREMIUM GRADE
Premium Grade products are utterly desirable – we'd eat nothing but beans until we could afford them.

PROFESSIONAL
Products worthy of the Professional award make you and your business appear even more awesome.

APPROVED
Approved products are those that do a great job for the money; they're the canny purchase for a great PC.

CUSTOM KIT
For those gadgets and gizmos that really impress us, or that we can't live without, there's the Custom Kit award.

LABS TEST

Case by case

The sub-£100 case market has become fiercely competitive recently. We put a baker's dozen through our Labs to find the cases that deserve your cash

Although there can be compelling reasons to splash out lots of money on a case, it isn't a necessity for most PC builds. Whether you just need a home for a standard PC, or you're looking to put your cash towards faster components, there's a seriously large selection of sub-£100 cases from which to choose.

It's this market category where most case manufacturers make the majority of their sales, and understandably so. As such, each company strives to produce cases that perform well, have plenty of features and make PC building simple, yet still have a wallet-friendly price tag.

That's not easy to achieve, but with so many manufacturers trying to do it, there's plenty of competition and choice. This situation is great for consumers, as it means the quality is driven upwards – the features and looks of the cases on test here generally exceed those of cases at similar prices from even a few years ago. The downside, however, is the potential for confusion over which ones are great and which are less so – it's easy to be fooled by a good-looking case that's functionally a letdown.

That's where we can help, as we've rounded up 13 sub-£100 cases – brand-new models and some old favourites – with prices starting at just £35, and put them through their paces in our Labs. Whatever your requirements, if you're looking for a decent, affordable case, we'll help you find the one that's just right for your next ATX build.

MATTHEW LAMBERT

Featured this issue

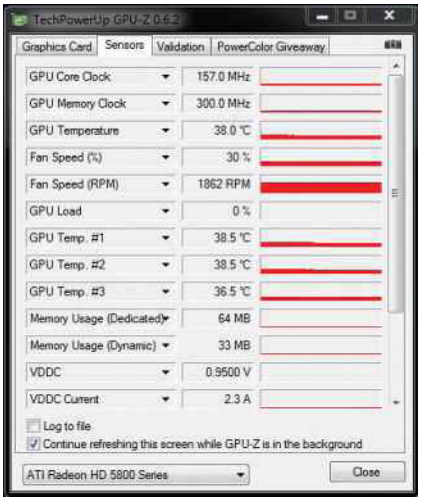
How we test

All cases in this Labs test are tested using our standard ATX test kit. This setup includes a Biostar TPower I55 motherboard fitted with an Intel Core i7-870 CPU and 4GB (2 x 2GB) of OCZ 1866MHz DDDR 3 memory. While this test rig isn't exactly a modern setup nowadays, we don't need it to be. What we need is a machine that will produce a relatively high and constant amount of heat. As such, we overclock the CPU from 2.93GHz to 3.41GHz using a 155MHz base clock and a 22x multiplier. The vcore is locked at 1.305V and the CPU PLL is set to 1.9V. We also disable any power-saving features to ensure that the frequency, and thus the heat output, is as consistent as possible.

The CPU is cooled by a Gelid Tranquillo cooler that's been fitted with a Noctua NF-S12B ULN 120mm fan. We run the fan at a fixed speed via a direct connection to one of the power supply's 12V Molex plugs. The use of a modest cooler and a slow-spinning, low-airflow fan is deliberate, as it places more of a burden on the case when it comes to dealing with the CPU's heat. Our overclock may not be massive, but the limited CPU cooling means the frequency is high enough for the CPU temperature to reach 80°C or even 90°C under load.

To see how well a case can cope with heat from the GPU, we use a Radeon HD 5870 1GB graphics card, running at stock speeds. The card is a reference design, so it uses a blower-style cooler where all heat is exhausted directly out of the rear of the card. This card and cooler is perfect for our needs, as it ensures that minimal hot air re-enters the chassis, and therefore tests how well a case can feed your graphics hardware with cool air. We use the AMD driver software to disable automatic fan control, and lock the fan to 30 per cent speed to prevent it from interfering with the results.

We run Unigine Heaven at 1080p to load the GPU, and record the GPU temperature using GPU-Z

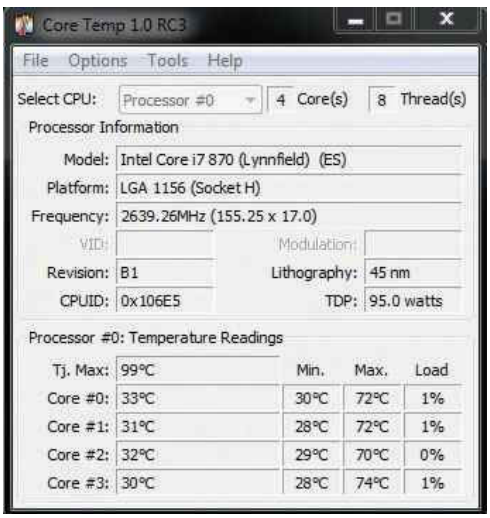


To test a chassis, we begin by doing a full system build, allowing us to determine the ease with which you can work with the case and assess its design. We may comment on aesthetics, but as this area is subjective, it doesn't count towards the final score. We also tidy cables away as best as the case allows, so that there's minimal interference with airflow.

Just as the CPU and GPU fans are run at constant speeds throughout testing, so too are the default fans supplied with a chassis. Like the CPU fan, these fans are connected directly to a 12V Molex plug, which will run all fans at full speed. If the case includes a fan controller, we hook up all case fans to it (not the CPU fan) and test at the maximum and minimum fan speeds. Finally, in the event that a case has a removable hard drive cage that potentially affects airflow, we test with it both installed and removed.

Once the test machine is built into the case, it's time for stress testing. We run Prime95's smallfft test to stress all CPU cores to 100 per cent load and, at the same time, run the Unigine Heaven benchmark at 1080p with default settings to place full load on the GPU cores.

After 15 minutes, which is enough time for temperatures to plateau, we note the maximum CPU core temperature as recorded by CoreTemp, and the maximum GPU temperature as reported by GPU-Z. Finally, we measure the ambient room temperature, and calculate the difference between it and the recorded values to produce a delta T result.



After 15 minutes, we note the maximum CPU core temperature as recorded by CoreTemp

Anidees AI-07BW / £77 inc VAT

SUPPLIER www.overclockers.co.uk

The AI-07BW is unique in this Labs for its dual chamber design, whereby the motherboard tray effectively splits the case in two. The priority is cooling; it keeps the core components almost entirely separate from the PSU and drives. That said, it has aesthetic benefits too, especially as there's a big window overlooking the main chamber.

The focus on cooling is clear from the ample fan mounts too. A whopping count of five 120mm fans are included by default; more than any other case on test. There are four blue LED intake models at the front and a standard rear exhaust, creating a positive air pressure design that should help to naturally exhaust hot air through the copious ventilation. The fans can all be controlled by the included fan controller, although its switch is rather unhelpfully installed at the back.

Thankfully, the AI-07BW is also well guarded against dust in all areas that matter. The top mesh/filter combo simply clips out, while the bottom filter has a handy rail mechanism. The thin front filter and internal PSU filter are harder to access, but at least they're included.

Overall build quality is good too – other than the meshed areas, the Anidees is an all-steel case externally, and the rubber feet keep it grounded too. The core chassis is also strong without the panels attached, but there are some areas that need work – the plastic drive trays are on the flimsy side and the clip-out roof section needs to be aligned better with the main panel. The side panels also use slightly awkward notches and rails, but once you're inside, the pre-installed motherboard standoffs help the build process, and there's plenty of clearance for large coolers and GPUs.

There are two 3.5/2.5in trays in the top section just behind the front 5.25in bay, and a further two 3.5/2.5in trays in the cage behind the motherboard tray.

This cage is removable and has an extra dedicated 2.5in mount on its side – all are easy to use. You also get a good selection of front panel USB ports; along with the power and reset buttons, these should be easy to reach however you position the case.

With an ATX motherboard installed, there are no dedicated cable-routing holes available, although you can route cables to the side into the secondary chamber, where there's plenty of space to keep clutter out of sight and build a tidy system. If you fill the drive trays above the motherboard, though, then getting cables to the top of your motherboard could prove tricky.

The top area can also house a slim 240mm radiator instead of internal/optical drives, and another two 240mm radiators can be installed in the front area, without any real thickness limitations other than your graphics card length. That's a decent level of water-cooling support.

The dual chamber design and five fans combined to give the AI-07BW the best cooling results overall: the CPU delta T of 53°C is only 1°C behind the best result, while the GPU result of 49°C is in top place. Even the low fan speed result is better than many of the other cases on test at their best, but turning off the fans quickly increases the heat.

Conclusion

The Anidees' cooling is very impressive, so if that's a top priority then the AI-07BW is certainly worth shortlisting. However, while there are benefits to its dual-chamber design, its few build quality issues and comparative lack of killer features make it struggle to stand out among strong competition.

COOLING	FEATURES	OVERALL SCORE
28/30	17/20	84%
DESIGN	VALUE	
24/30	15/20	

VERDICT

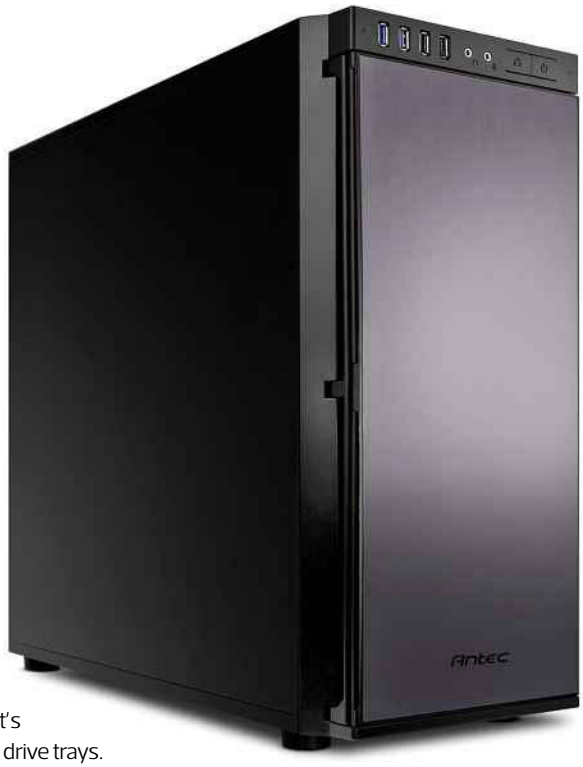
Unbeaten in the cooling department, but not quite polished enough to truly shine among excellent competitors.

/ SPECIFICATIONS

Dimensions (mm) 288 x 380 x 380 (W x D x H)
Material Steel, plastic
Available colours Black, white
Weight 6.35kg
Front panel Power, reset, 2 x USB 3, 2 x USB 2, headphone, mic
Drive bays 1 x 5.25in, 4 x 3.5in/2.5in, 1 x 2.5in
Form factor(s) ATX, micro-ATX, mini-ITX
Cooling 1 x 200mm or 2 x 140mm or 4 x 120mm front fan mounts (4 x 120mm fans included), 1 x 120mm and 1 x 92mm rear fan mounts (120mm fan included), 2 x 140mm/120mm roof fan mounts, 1 x 120mm bottom fan mount
CPU cooler clearance 174mm
Maximum graphics card length 348mm
Extras Removable dust filters, fan controller

Antec P100 / £63 inc VAT

SUPPLIER www.overclockers.co.uk



The Antec P100 has been around for a few years now. It carries signature styling for a low-noise case, with its plain, minimalist panels clad in black. Build quality on the whole is very good, but a few parts are indicative of the low price, such as the plastic front panel. The brushed aluminium effect on this panel's door is attractive though.

The front I/O panel is well connected and positioned just above the top edge of the door. Opening this door reveals a pair of 5.25in drive bays, which use tool-free clips for installation. The door is also backed by noise-deadening foam, as are the side panels. Similarly, the drive trays, PSU area and case feet all have anti-vibration features.

The Antec P100 ships with two 120mm fans – one acting as a front intake and the other as a rear exhaust. The front has room for an extra fan, while two 140mm or 120mm fans can go in the roof as well. While there's no dedicated fan controller, both fans have their own switch to toggle between high and low speed. However, these switches just dangle awkwardly at the end of cables, and they aren't externally accessible, so you basically have to set and forget them.

Meanwhile, the front dust filter clips out easily with the door open, and the slide-out one beneath the PSU is easily accessed too. The two top fan mounts are blocked by blanking plates by default, which is good for a low-noise case, although no dust filters are provided for these mounts in case you want to use them later.

When you want to get inside the P100, the front hinge design and handles on the side panels make for easy removal. The internal design itself is standard for an ATX tower, with no fancy modern touches such as a PSU cover, although hardware installation is generally very easy, with most of the motherboard mounts pre-installed. The cage holding the stack of seven drive trays at the front is non-removable, but the case is still long enough to accommodate monster graphics cards anyway. It's also very easy to work with these drive trays.

Water-cooling isn't a strong point for the P100 though. Slim 240mm, and maybe 280mm, radiators will fit in the roof with one row of fans, but that's about it. The grommets on the cable-routing holes also come off too easily when pushing thick cables through them, but the position and size of the holes are useful. There's also adequate space behind the motherboard tray for cables, and the hinged panels remain easy to replace even when this area is crowded.

Perhaps what's most surprising about the P100, though, is the cooling ability. Granted, the fans are audible when they're running at full speed, but they're not loud, and the chassis definitely absorbs at least some sound. Nevertheless, it managed just as good a CPU result as the NZXT H440, putting it in joint second place, even with the roof blanking plates left in place (since filters aren't provided). The GPU delta T of 53°C is also respectable.

Even at minimum fan speed, cooling ability remains competitive and the P100 is nowhere near as warm as a number of other cases.

The P100 demonstrates a tried and tested thermal design, and the fans strike a good balance of airflow and noise.

Conclusion

The P100 is a solid, no-frills chassis that doesn't get much wrong, but lacks the pizzazz and flexibility to stand out against the newer competition. Nevertheless, it's ideal if you're looking for a cost-effective, low-noise chassis that still offers decent cooling.

COOLING	FEATURES	OVERALL SCORE
27/30	14/20	84%
DESIGN	**VALUE**	
26/30	17/20	

VERDICT

Not the most exciting case, but the P100 holds its own very well a few years after release – a good option for a wallet-friendly, low-noise build.

/SPECIFICATIONS

Dimensions (mm) 220 x 523 x 484 (W x D x H)
Material Steel, plastic
Available colours Black
Weight 8kg
Front panel 2 x USB 3, 2 x USB 2, headphone, mic
Drive bays 2 x 5.25in, 7 x 3.5in/2.5in
Form factor(s) ATX, micro-ATX, mini-ITX
Cooling 2 x 140mm/120mm front fan mounts (1 x 120mm fan included), 1 x 120mm rear fan mount (fan included), 2 x 140mm/120mm roof fan mounts
CPU cooler clearance 170mm
Maximum graphics card length 317mm
Extras Removable dust filters, internal fan control switches

Be Quiet! Silent Base 600 / £90 inc VAT

SUPPLIER www.scan.co.uk

The Silent Base 600 is one of the more expensive cases in our Labs, but the build quality reflects its price for the most part, and you can save a little cash by purchasing the non-windowed version too. The steel panels and structure are rigid, and all the parts, including the window, are neatly aligned, although the plastic on the front panel is a little too thin.

South of the generously equipped I/O panel is a half-height magnetic front door, which can be rehinged to open in either direction as needed. Behind this door sit the fan control switch and the covers for the three optical drive bays. The fan controller has three speed settings and can power up to three fans; by default this setup includes the 140mm front intake and 120mm rear exhaust fans. In addition, there are four more fan mounts available to boost airflow.

With the door open, you can also slide up the dust filter guarding the front intake area. It's a neat mechanism that's complemented by the bottom slide-out dust filter for the PSU and fan mount in this area. The roof has a small series of vent slits too, but they're not big enough for dust to be a pressing issue, so the absence of a filter there is unimportant.

It's fairly easy to work with the side panels, but the roof and front panels require awkward unclipping from within the case. With the case open, you quickly see the focus on noise reduction. Sound-deadening material lines the back of multiple panels, while big rubber case feet, the double-layered window, a fully isolated PSU mounting area and the rubberised hard drive mounting arms all aim to quell noise and vibrations.

Any 5.25in drives are installed with simple tool-free clips but the cage itself is locked in place. Still, the single hard drive cage, accommodating three 3.5in drives and a single 2.5in drive, can be removed via three thumbscrews. It can then be hung off the 5.25in cage or installed inside it to clear out the lower front section for boosted airflow. Meanwhile, two dedicated trays behind the motherboard cater for SSDs.

However, there's no official support for radiators in this lower front area. It shouldn't be hard to install one with a few modifications, and slim 240mm and 280mm radiators (and possibly thicker 240mm radiators, depending on your other components) are supported in the roof, but this area is just begging for large radiator support.

On the plus side, the cable-routing system is good, with grommets covering suitably large holes and a decent amount of room behind the motherboard, although more anchor points would be useful. Another neat touch is the black sleeved internal cables, which provide a consistent look.

The maximum speed delta T result of 55°C for the CPU isn't bad at all either, although 58°C for the GPU is more middle ground. Removing the hard drive cage has no effect on the CPU temperature, which is more reliant on the exhaust fan, but the GPU gets 1°C cooler. Both components are affected when you lower the fan speeds, but the CPU much more so, suggesting that the roof vents have limited impact. The case is definitely on the quiet side too, even at full speed.

Conclusion

The Silent Base 600 is far from a bad chassis, and it impresses in a number of areas, especially the attention to detail and focus when it comes to noise reduction. However, its comparatively high price makes it hard to recommend next to the feature-rich and cool NZXT H440 (see p50).

COOLING	FEATURES	OVERALL SCORE
25/30	15/20	80%
DESIGN	**VALUE**	
27/30	13/20	

VERDICT

A mostly well-rounded case that's focused on noise reduction, but it misses a trick in a few areas and is a little overpriced.

/SPECIFICATIONS

Dimensions (mm) 230 x 495 x 493 (W x D x H)
Material Steel, plastic, nylon
Available colours Black, black and orange, black and silver
Weight 8kg
Front panel Power, reset, 2 x USB 3, 2 x USB 2, headphone, mic
Drive bays 3 x 5.25in, 3 x 3.5in, 3 x 2.5in
Form factor(s) ATX, micro-ATX, mini-ITX
Cooling 2 x 140mm/120mm front fan mounts (1 x 140mm fan included), 1 x 120mm rear fan mount (fan included), 2 x 140mm/120mm roof fan mounts, 1 x 140mm/120mm bottom fan mount
CPU cooler clearance 167mm
Maximum graphics card length 290mm (400mm without hard drive cage)
Extras Removable dust filters, fan controller

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BitFenix Shinobi / £50 inc VAT

SUPPLIER www.overclockers.co.uk

The Shinobi is a bit of a veteran in BitFenix's line-up, but it's still readily available and has been given a few minor upgrades for the modern age. One such upgrade is the addition of USB 3 to the front panel, although fan control isn't included. The steel and plastic construction is standard now, but it isn't poor quality and the soft-touch finish on the plastic front and roof adds a little class. The core chassis flexes without the panels attached, but the same is true for most cases in this price range.

The Shinobi rests on foam feet, rather than the preferred rubber ones, but that's still better than the exposed plastic on the In Win and SilverStone cases.

You only get one fan bundled though – a 120mm rear exhaust. That's stingy for a £50 case, but at least the Shinobi isn't short of fan mounts, sporting six in total. That said, there's essentially zero water-cooling support in this case.

The side panels use notches and rails like most of the cases on test, so they can be fiddly to get back onto the case. The front panel pulls away cleanly, but the roof brings all of the I/O cables with it, which isn't ideal if you've already finished your build and want to clear that top mesh/filter section.

Both the front and PSU are protected by dust filters too, but sadly, these filters are little more than thin, fiddly fabric sheets with no easy access mechanisms.

Like the Antec P100, the Shinobi has a very standard ATX mid-tower layout. A few standoffs come installed out of the box, and the PSU has small foam pads on which to rest, although it's not isolated from the rear panel in any way. The drive arrangement is where the Shinobi most shows its age though. For starters, three 5.25in bays are more than anyone needs these days. There are no tool-free clips on any of the drive bays either. Support for 2.5in drives has also only been added after the original design – inside one of the 5.25in bays is a plastic 3.5in/2.5in adaptor, which is the only place to install an SSD. That's because the stack of eight 3.5in mounts below it are spaced only to accommodate larger hard drives. Admittedly, most budget systems will only need one SSD anyway.

The hard drive cage can't be removed either, but there's still a lot of clearance for long graphics cards, although hard drives face forwards, rather than sideways, posing issues for cable routing. The Shinobi isn't terrible in this area, though, with routing holes to the side of the motherboard as well as above and below it, albeit without any grommets. There's a surprising amount of space behind the motherboard tray too, given that the case is only 205mm wide.

The single fan does a decent job of looking after the CPU, keeping it at a delta T of 56°C, which is only 4°C off the top spot – the roof ventilation probably helps as well. The GPU, at 57°C, could be worse, but only the Thermaltake Versa N21 has a warmer result that isn't taken from a low fan-speed setting. One plus point is that the Shinobi is quiet – it contains sound well and the rear fan doesn't make much noise at all.

Conclusion

Despite a couple of attempts to modernise the Shinobi, it can't keep up with the competition. It offers reasonably good quality, and with a lower cost it would be worth considering. However, in this price league, you would be much better served by the Phanteks P400S (see p52).

COOLING	FEATURES	OVERALL SCORE
24/30	12/20	71%
DESIGN	**VALUE**	
19/30	16/20	

VERDICT

A good case for its age, but the Shinobi is unable to compete with newer, similarly priced cases.

/SPECIFICATIONS

Dimensions (mm) 205 x 490 x 460 (W x D x H)
Material Steel, plastic
Available colours Black, white
Weight 5.9kg
Front panel Power, reset, 2 x USB 3, 2 x USB 2, headphone, mic
Drive bays 3 x 5.25in, 1 x 3.5in/2.5in, 8 x 3.5in
Form factor(s) ATX, micro-ATX, mini-ITX
Cooling 2 x 120mm front fan mounts, 1 x 120mm/92mm rear fan mount (120mm fan included), 2 x 140mm/120mm roof fan mounts, 1 x 120mm bottom fan mount
CPU cooler clearance 161mm
Maximum graphics card length 320mm
Extras Removable dust filters

Cooler Master CM 690 III / **£87** inc VAT

SUPPLIER www.ebuyer.com

The CM 690 III is dominated by mesh at the front and top, with an extruded right panel help with cable management and a large window on the left. This case ranks in the upper echelons for build quality, using rigid plastic to create a stable for chassis with lots of grip. The I/O panel is guarded by a glossy plastic cover that slides back to reveal the ports and a small cubbyhole where you could store accessories or rest your charging phone. There's no fan controller included though.

A 200mm front intake fan is joined by a 140mm rear exhaust, and there are plenty more fan mounts – the non-windowed version even adds side mounts. The front, roof and PSU are all covered by dust filters, and they're mostly easy to access, although you need to remove a screw before you can lift out the top section. Case access is generally okay, but a hinged panel design would be preferable to the notches and rails. The front and roof are also pretty stiffly attached. Thankfully, there are no surprises with the layout and clearance is ample.

Optical drives are secured with single-sided tool-free clips, which function well enough. Below the 5.25in bays are two 3.5in/2.5in drive cages. The top one can house four drives and the lower one has room for three. A neat feature is the ability to collapse the internal wall of the upper drive cage so that it only supports 2.5in drives (the drive trays also shrink to this size), giving you more clearance for your primary graphics slots. This wall can also be fitted with a 120mm fan to raise internal airflow.

There are a further three dedicated SSD mounts on the case floor, the bottom of the 5.25in drive cage and behind the motherboard tray, all requiring you to install washers to your drive before sliding it into place.

Meanwhile, cable routing is straightforward – big holes with very secure rubber grommets let you feed cables into the area behind the motherboard, where the extruded panel really helps. There are no fancy features such as Velcro cable ties, and no routing is done for you, but it's easy to tidy your build.

Water-cooling enthusiasts can mount a 240mm slim radiator with fans in the top mounts, although the front has more space. You need to remove both drive cages to open it up, which is a pain, thanks to the sheer number of screws used, but the lower cage can be moved further back into the case rather than removed completely – useful if you want to retain 3.5in drive support. In this state, slim 240mm radiators can be installed with push-pull fans, or full-thickness radiators with one row of fans.

The ample ventilation and two large fans result in very good cooling ability. The CM 690 III doesn't top the charts, but it's only 1-2°C off of the best results, so you have nothing to worry about. It isn't very loud either, although equally it's not designed as a low-noise case, so don't expect near-silence.

Conclusion

The CM 690 III is a seriously strong entry from Cooler Master. We wish it was still at its launch price of £80 inc VAT, though, as its current price of £87 inc VAT puts it just a little too close to the NZXT H440 (see p50), which just steals the award once you account for everything. That said, the CM 690 III remains a fine case, and is recommended if you can find it cheaper, or if you just prefer its looks to that of our award winners.

COOLING	FEATURES	OVERALL SCORE
28/30	17/20	85%
DESIGN	**VALUE**	
26/30	14/20	

VERDICT

An excellent case that can accommodate and cool plenty of high-end hardware, although its price pits it against serious competition.

/SPECIFICATIONS

Dimensions (mm) 230 x 502 x 507 (W x D x H)
Material Steel, plastic
Available colours Black, black and white, black and green
Weight 8.9kg
Front panel Power, reset, 2 x USB 3, 2 x USB 2, headphone, mic
Drive bays 3 x 5.25in, 7 x 3.5in/2.5in, 3 x 2.5in
Form factor(s) ATX, micro-ATX
Cooling 1 x 200mm/180mm or 2 x 140mm/120mm front fan mounts (200mm fan included), 1 x 120mm rear fan mount (fan included), 1 x 200mm or 2 x 140mm/120mm roof fan mounts, 1 x 120mm bottom fan mount, 1 x 120mm internal HDD cage mount
CPU cooler clearance 171mm
Maximum graphics card length 423mm
Extras Removable dust filters

Corsair Carbide Series 400C / £72 inc VAT

SUPPLIER www.scan.co.uk

The 400C impresses as soon as you lay eyes and hands on it. While some plastic is used, the external surfaces are all steel, except for the large windowed side panel. It's sturdy and solid on the outside, and the latched window grants you very easy access to the inside, although the right panel is screwed into place as usual.

Corsair has ditched optical drive support entirely, leaving a completely solid front fascia with large vents down the sides. These vents serve the intake area where a 140mm fan is installed, while a 120mm model handles rear exhaust duties. You don't get any fan control, however. The roof, front and PSU are all guarded against dust. The top filter is magnetic, simply peeling off whenever it needs cleaning. The front one is hidden behind the panel, but that too comes off easily, while the PSU one slides out from behind.

Opening the side door reveals a spacious interior and pre-installed motherboard mounts. You also get a PSU cover, resulting in a very clean internal design. The cover is formed of two overlapping pieces, so you can remove the front one to make room for large front radiators but still keep the PSU and most cables hidden. It's a good idea in theory, but the design needs work. Firstly, the material is flimsy plastic, contrasting with the rest of the case.

You also have to remove both parts to install the PSU, which rests on rubber standoffs, but aligning and securing the even flimsier clips is needlessly laborious.

With the cover off, you reveal a two-bay hard drive cage near the front with tool-free 3.5in trays, and support for 2.5in drives too. You also get a triple-bay dedicated SSD mount behind the motherboard tray, with fantastic tool-free, spring-based locking arms. Other than the PSU cover issues, building in this case is very quick and easy.

Tidying cables is mostly simple – the PSU cover hides excess power cables, and three large routing holes with rubber grommets serve the main chamber. There are no holes directly beneath the motherboard, thanks to the PSU cover, so you may have to leave more I/O cables in sight than you'd prefer. Also, the space behind the motherboard tray is compromised by the SSD unit – you have to route all your cables around it, which can be fiddly.

For water-cooling gear, 240mm radiators can be installed in the roof, with offset mounts ensuring thick setups should be possible. You can install 240mm radiators in the front too, but by removing the front part of the PSU cover and the hard drive cage, you also get 360mm and 280mm radiator support. These radiators can be as thick as you like, depending on the length of your graphics card. There are, however, no real concessions for reservoirs or pumps.

In terms of cooling, the CPU delta T of 59°C is in the bottom third in this group test, and although the GPU result isn't as bad, the results definitely aren't as good as the spacious interior suggests. It isn't a loud case, admittedly, but neither is it extremely quiet. Of course, there are plenty of expansion options for both air and water-cooling gear, but the results are still a tad disappointing.

Conclusion

The 400C's features are comparatively stripped back, and the cooling isn't spectacular, but it has everything crucial and, although the PSU cover needs work ,it's still one of the better-designed cases in this test overall. The price is also pretty good, but that isn't enough to give it the edge over the better-value and cooler Fractal Design Define S.

COOLING	FEATURES	OVERALL SCORE
24/30	14/20	80%
DESIGN	VALUE	
27/30	15/20	

VERDICT

Excluding some niggles, the 400C is very well designed, but it's set back by mediocre out-of-box cooling and a relatively light feature set.

/SPECIFICATIONS

Dimensions (mm) 215 x 425 x 464 (W x D x H)
Material Steel, plastic
Available colours Black, white
Weight 8.2kg
Front panel Power, reset, 2 x USB 3, headphone, mic
Drive bays 2 x 3.5in/2.5in, 3 x 2.5in
Form factor(s) E-ATX, ATX, micro-ATX, mini-ITX
Cooling 2 x 140mm or 3 x 120mm front fan mounts (140mm fan included), 1 x 120mm rear fan mount (fan included), 2 x 140mm/120mm roof fan mounts
CPU cooler clearance 170mm
Maximum graphics card length 370mm
Extras Removable dust filters, PSU cover

Fractal Design Define S / £70 inc VAT

SUPPLIER www.scan.co.uk

Fractal's Define S is rather plain-looking but its minimalism has a certain elegance. Plastic is used on the front and roof but, on the front at least, it has an attractive faux brushed-metal finish. Steel is used everywhere else, with overall high build quality and thick rubber feet.

The front panel is solid, aside from the side ventilation sections, and there's no need for a door, since there's no fan controller nor optical drive mounts to access. The panel does pull off, though, revealing a full-height dust filter for the intake area where a 140mm fan is fitted. A second 140mm fan is mounted as a rear exhaust, but there's space for an impressive eight in total.

The PSU and bottom fan mount are covered by a slide-out dust filter, although it can be tricky to get back into place – the case could do with a little more clearance here. The top three fan mounts, meanwhile, are protected by individual blanking plates, although they're a little fussy to remove, requiring you to unclip them from inside. You don't get dust filters for this area, however, so you should only remove these plates if you're installing fans or a radiator in exhaust mode here.

The side panels are held in place with captive thumbscrews, which are a neat touch, but the notches and rails system are less appreciated. There's also noise-dampening on the right side panel, but you don't get any on the large windowed panel. On the plus side, the PSU is properly isolated from the case, although there's no PSU cover as seen in the Phanteks or NZXT cases.

What makes the S model notably different from Fractal's similar R5 is the lack of 5.25in or 3.5in drive cages, meaning that the main working area is extremely spacious with massive amounts of clearance. It gives airflow a very clear path, and also nets the Define S outstanding water-cooling support for a £70 mid-tower. You can fit 280mm and 360mm radiators in the front, while the roof supports 360mm and even 420mm models. Roof radiators based on 140mm fans are limited to slim models only, but thicker setups can be installed when you use ones with 120mm fans, thanks to offset mounting holes. You can also use two 360mm radiators together without conflict. Furthermore, at the front of the elongated motherboard tray is a set of reservoir mounting points, as well as a pump mounting area built into the floor.

All drives are installed behind the motherboard tray on individual metal trays released via a single thumbscrew. You do need screws for all drive types, but it's a quick process and 3.5in drives have anti-vibration mounting points too. The Define S could do with a more space for cable management, but the routing holes are large and covered by rubber grommets. All internal cables are black for consistency too, and the Velcro cable ties are a real bonus, making tidying much easier than usual.

The open interior results in very good airflow as well. The large 140mm at the back pushes the Fractal to the top of the CPU cooling charts in this test, with a delta T of 52°C. The same delta T for the GPU is also a strong result. There's no fan control, but the Define S is still pretty quiet, even with the two fans at full speed.

Conclusion

The Define S cools well out of the box without much noise, and offers plenty of room for expansion and water-cooling gear. A fan controller and PSU cover would be welcome, but most key features are covered. It's one of the easiest cases to work with too, and the price is fair.

COOLING	FEATURES	OVERALL SCORE
28/30	15/20	86%
DESIGN	**VALUE**	
26/30	17/20	

VERDICT

A plain exterior belies a very well-rounded, modern chassis suitable for budget and high-end builds that's also user-friendly and keenly priced.

/ SPECIFICATIONS

Dimensions (mm) 233 x 533 x 465 (W x D x H)
Material Steel, plastic
Available colours Black
Weight 8.5kg
Front panel Power, reset, 2 x USB 3, headphone, mic
Drive bays 3 x 3.5in/2.5in, 2 x 2.5in
Form factor(s) ATX, micro-ATX, mini-ITX
Cooling 3 x 140mm/120mm front fan mounts (1 x 140mm fan included), 1 x 140mm/120mm rear fan mount (140mm fan included), 3 x 140mm/120mm roof fan mounts, 1 x 140mm/120mm bottom fan mount
CPU cooler clearance 180mm
Maximum graphics card length 425mm
Extras Removable dust filters, fan mount blanking plates

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In Win 503 / **£50** inc VAT

SUPPLIER www.box.co.uk

The standout feature of the In Win 503 is its tempered glass front panel. This material is practically never seen at this price point, and it certainly adds some appeal.

It's fitted on a mechanism that allows it to slide up and down, revealing or hiding the single external 5.25in bay as needed, although it's prone to picking up fingerprints.

Elsewhere, build quality is acceptable but nothing special – there are no major flaws but the steel is quite thin, the extruded window looks tacky and the case stands on plastic rather than rubber or foam feet, meaning its grip is weak. The other panel is extruded too, which should aid cable routing, while the roof is flat, featureless and riveted in place.

Features aren't a strong point; the 503 has just one USB 3 port compared to two on nearly all other cases. You do get a pair of 120mm fans, but with only four mounts there are limited expansion options and there's zero water-cooling support. The rear exhaust fan is a red LED model, though, which adds a little pizzazz.

While the 503 technically has full protection against dust at the front and on the bottom, the filters are little more than thin sheets. They're technically removable, but it's a fiddly process, especially getting them back on. Also, the front panel has to be removed to access the front filter, and it doesn't come away cleanly, instead pulling on all the I/O cables.

Inside, it's good to see the standoffs built into the motherboard tray, but otherwise there's not much exciting internally. The PSU does have rails on which to rest, but they're not covered in rubber or foam so there's no isolation from the chassis.

While only one 5.25in bay is externally accessible, the fixed cage has room for three 5.25in devices, so it's mainly only useful if you purchase extra adaptors. Meanwhile, the internal drive cage, also riveted in place, can house up to six drives, and 3.5in drives can be installed tool-free on plastic trays that aren't too flimsy. The cage also leaves room above it for long graphics cards, although oddly, In Win has installed the front fan behind the cage instead of above it where there's a clearer airflow path. Still, the solid front panel will hinder a lot of airflow either way.

Meanwhile, the cutaway at the bottom of the motherboard tray, combined with the extruded side panel, creates lots of room for cable management, but not in a neat way. The other routing holes are small and not fitted with grommets, and there isn't one above the motherboard tray either.

Sadly, the I/O cables aren't all black either, further adding to potential eyesores visible through the window.

Cooling ability isn't that impressive either. The results aren't awful, but the competition is superior. The 503 managed the joint worst CPU delta T, excluding lowered fan speed results. With a fairly slow spinning 120mm rear exhaust and a sealed roof, this result isn't that surprising. It's better at GPU cooling, where it's mid-table in this group test, but there are still many better outcomes.

Conclusion

Tempered glass is an awesome material, and it's especially exciting to see it in a £50 chassis. However, this glass is almost all the 503 really has going for it when compared with other cases in this price league. While the 503 is a solid, functional chassis, the design is quite restrictive and uninspiring – despite the attractive glass front, there's little point in paying £50 for the 503 when the Phanteks P400S costs just £5 more.

COOLING	FEATURES	OVERALL SCORE
23/30	11/20	67%
DESIGN	**VALUE**	
18/30	15/20	

VERDICT

It's interesting to see a premium material in such low a price bracket, but the knock on effect on other areas makes this case uncompetitive.

/SPECIFICATIONS

Dimensions (mm) 210 x 473 x 440 (W x D x H)
Material Steel, tempered glass
Available colours Black and red, white and black
Weight 5.9kg
Front panel Power, reset, 1 x USB 3, 2 x USB 2, headphone, mic
Drive bays 3 x 5.25in, 4 x 3.5in/2.5in, 2 x 2.5in
Form factor(s) ATX, micro-ATX, mini-ITX
Cooling 2 x 120mm front fan mounts (1 x 120mm fan included), 1 x 120mm rear fan mount (fan included), 1 x 120mm bottom fan mount
CPU cooler clearance 200mm
Maximum graphics card length 408mm
Extras Removable dust filters, fan controller

Nanoxia CoolForce 2 / £75 inc VAT

SUPPLIER www.quietpc.co.uk

The brand-new CoolForce 2 from Nanoxia impresses at first, thanks to its rugged steel exterior and weighty panels – it feels built to last. The three-step fan controller can power the three included 140mm fans, and at the bottom of the front panel, there's a button that turns the two vertical green LED strips behind the front panel on and off.

The roof has a removable plastic section to expose the trio of fan mounts. It's a good mechanism, but dust filters aren't supplied – if you only need to install one or two fans here, a fan mount or two will be left open. Thankfully, the front and bottom are dust-shielded, although neither design is ideal. Refitting the bottom filter after cleaning is fussy work, while the front one necessitates the front panel's removal, which drags out all the I/O cables too. The side panels are also problematic, as the notches and rails system is poor at realigning properly, which makes closing up the case awkward.

On the plus side, there's loads of room, with XL-ATX support equating to eight expansion slots. No standoffs are installed, but the PSU is properly isolated from the chassis. In fact, noise isolation is a strong point, with plenty of noise-dampening material fitted.

Meanwhile, both 5.25in drive bays feature tool-free locks in their removable cage. At the front is a big vertical column with three dedicated 2.5in trays, each released with its own thumbscrew. A fourth tray is also included behind the motherboard tray, and Nanoxia helpfully includes right-angled and straight SATA data/power extension cables, as well as an 8-pin CPU power extension cable. Hidden from view behind this column you'll also find a removable, two-bay 3.5in/2.5in drive cage on the floor, with anti-vibrations fitting.

Bridging the gap between the SSD column and the motherboard tray is Nanoxia's ModuWand, installed parallel to the front panel. While the ModuWand cuts GPU clearance to a still decent 300mm, it can be used for a wide variety of jobs. Firstly, it can accommodate two SSDs and two hard drives, although they need to be installed back to back. Alternatively, you can mount one or two fans on it – the CoolForce 2 has a whopping nine fan mounts in total, more than any other case on test. It's also possible to install pumps and reservoirs here or, of course, you could just remove it.

Cable routing is a mixed bag though – there are plenty of holes and rubber grommets, but nothing is pre-connected for you (such as the fan controller), and the Velcro cable ties aren't anchored anywhere, which makes them hard to tighten effectively.

On the plus side, the CoolForce 2's water-cooling support is very good – any thickness of 240mm radiator can be installed in the front, while up to 360mm radiators can be fitted in the roof. You should be able to fit a full-thickness radiator in the roof too, but you'll likely need to use low-profile memory.

In terms of airflow performance, at maximum fan speed, the GPU delta T is very good at 51°C, although the CPU delta T is fairly warm at 59°C. However, removing the drive cage and ModuWand improves the CPU result by 2°C, while worsening the GPU result by the same amount. While the minimum speed result is a little too hot, the medium setting provides a good balance between noise and performance.

Conclusion

The CoolForce 2 is a decent case with tonnes of features and some good ideas, such as the flexibility of the ModuWand. However, in a few places the user experience isn't quite at the necessary level to compete with other cases in this league.

COOLING	FEATURES	OVERALL SCORE
26/30	19/20	82%
DESIGN	**VALUE**	
22/30	15/20	

VERDICT

Flexible and rammed with features, but slip-ups in usability cost the CoolForce 2 a few points.

/SPECIFICATIONS

Dimensions (mm) 200 x 475 x 430 (W x D x H)
Material Steel, plastic
Available colours Black
Weight 9.9kg
Front panel Power, reset, 2 x USB 3, 1 x USB 2, headphone, mic
Drive bays 2 x 5.25in, 2 x 3.5in/2.5in, 2 x 3.5in, 6 x 2.5in
Form factor(s) XL-ATX, ATX, micro-ATX, mini-ITX
Cooling 2 x 140mm/120mm front fan mounts (2 x 140mm fans included), 1 x 140mm/120mm rear fan mount (140mm fan included), 3 x 140mm/120mm roof fan mounts, 1 x 140mm/120mm bottom fan mount, 2 x 140mm/120mm internal fan mounts
CPU cooler clearance 185mm
Maximum graphics card length 430mm
Extras Removable dust filters, fan controller, front LEDs

NZXT H440 2015 Edition / £95 inc VAT

SUPPLIER www.overclockers.co.uk

The H440 was renewed last year with a few minor upgrades. It's the most expensive chassis on test, but its look and feel is a cut above the rest. The build quality is the best on test, and the new matt finish is lovely. Aesthetically, it's sleek and minimalist without being boring, and the tinted window on our all-black sample adds further class.

The I/O panel is well connected, and while there's no external fan control, it includes an internal PWM fan hub, enabling you to connect eight (or more with splitter cables) fans and control them from the CPU fan header's PWM socket for automatic, case-wide fan control. It's a great idea, especially as many motherboards now offer advanced fan control tweaking. You get four fans already out of the box, all pre-connected the PWM hub, so airflow should be good, and there's room to add up to three more fans in the roof.

Another cool feature is the rear I/O panel LED, helping you to find that pesky USB port in the dark. There's also the NZXT logo on the PSU cover, which is visible through the window and backlit in white. Both lights are toggled with a button on the back – you can switch on one, both or neither of them.

The front and roof panels both pull off easily, giving you access to the full-height dust filter up front. The roof doesn't need a filter, since the top is solid and the ventilation is relegated to the sides where dust will struggle to enter. Lastly, the PSU is covered by an easily replaceable slide-out filter. One of our only grudges is that the side panels rely on notches and rails, although on the plus side, the H440 includes sound-dampening material on all its removable panels.

Meanwhile, pre-installed standoffs make motherboard installation a cinch, while the PSU needs to be attached to a bracket and slid into place from the back. The H440 includes five drive trays up front, which are all independently removable and capable of housing one 3.5in drive and a secondary drive, either 2.5in or 3.5in. Another universal mount is built into the floor, and there are two dedicated 2.5in mounts on the PSU cover, enabling you to show off an SSD or two.

When it comes to system building, there are plenty of hooks to secure cables, and lots of useful holes as well, including many with grommets. What's more, the PSU cover gives you masses of space for tidying cables – it's super-easy to build a neat and tidy rig with this case. There's plenty of room for water-cooling gear too, with space for 360mm or 280mm radiators both in the roof and up front, although the top is limited to slim models. There's no built-in place for reservoirs or pumps, but you still get a solid level of support.

In terms of airflow, the H440's CPU delta T of 53°C and GPU delta T of 51°C are 1°C and 2°C behind the best results respectively – this case doesn't struggle with cooling. These results were achieved with the fans at full speed, where the case generates a moderate but non-intrusive level of noise., but there's clearly plenty of leeway for lower, PWM-based speeds to deliver healthy temperatures.

Conclusion

The H440 2015 Edition is sublime. It cools hardware very well, has awesome features such as the PWM fan hub, PSU cover, double-sided drive trays and I/O LED, and it's also easy to work with the case and tidy your build. It's the most expensive on test, but it works very hard to justify it.

COOLING	FEATURES	OVERALL SCORE
28/30	19/20	90%
DESIGN	**VALUE**	
28/30	15/20	

VERDICT

The H440 2015 Edition ticks all the right boxes, with great cooling, plenty of hardware support, killer looks and nifty features. Well played, NZXT.

/ SPECIFICATIONS

Dimensions (mm) 220 x 480 x 513 (W x D x H)
Material Steel, plastic
Available colours Black, white, black and red, black and blue
Weight 10.16kg
Front panel Power, reset, 2 x USB 3, 2 x USB 2, headphone, mic
Drive bays 6 x 3.5in/2.5in, 5 x 3.5in, 2 x 2.5in
Form factor(s) ATX, micro-ATX, mini-ITX
Cooling 2 x 140mm or 3 x 120mm front fan mounts (3 x 120mm fans included), 1 x 140mm/120mm rear fan mount (140mm fan included), 2 x 140mm or 3 x 120mm roof fan mounts
CPU cooler clearance 180mm
Maximum graphics card length 428mm
Extras Removable dust filters, PWM fan hub, I/O panel LED, internal logo LED

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Phanteks Eclipse P400S / £55 inc VAT

SUPPLIER www.overclockers.co.uk

For a £55 case, the P400S is surprisingly weighty and sturdy. It has an all-metal exterior, with the roof and front panels, which are plastic at their core, having external steel layers. The case stands on foam, rather than rubber feet, but this material still does an okay job.

The I/O panel sports the usual USB 3 and audio ports, and there are fan control and LED control buttons tucked beneath the front lip. The former can control three fans at three different speeds, while the latter cycles the power button and front underglow LEDs through ten different colours, with additional connectors on the inside that can synchronise with optional Phanteks LED strips.

You only get two fans, both 120mm, but there are many expansion options, including extra fan mounts in the roof, which are covered by blanking plates. Unlike many manufacturers, Phanteks has seen the sense to provide separate dust filters for these mounts, so you can open them up just for extra ventilation without compromising your protection against dust. Meanwhile, the PSU is guarded by a slide-out filter, and the front panel vents also have filtering.

There are lots of neat touches inside too, including pre-installed standoffs, all-black internal cables, plenty of noise-dampening material and foam pads to help isolate the PSU (although not fully). A full-length PSU cover ensures a tidy build and, like the Define S (see p46), there's no optical drive support and no hard drive cage in the main cavity.

Instead, there's a two-bay hard drive cage at the front of the lower section, as well as dual SSD trays behind the motherboard, which use Phanteks' excellent Drop-N-Lock system of rubber grommets to slide into place. All the drive mounts have anti-vibration measures in place too. Meanwhile, back in the main area, you can install up to four extra 3.5in/2.5in drive trays, purchased separately. These bays, however, would reduce graphics card clearance to 280mm.

You can only really use the front for water-cooling gear, as the roof lacks adequate clearance – an area where the Define S has a clear advantage. Still, you can get a 240mm or 280mm radiator in the front area, and even a 360mm one if you remove the lower hard drive cage and the front of the PSU cover. This job is achieved with screws, but it's still a much better system than that of the Corsair 400C.

Phanteks has a good reputation for cable routing, and the P400S is no exception. All cables are neatly pre-routed and the LED and fan controllers come hooked up and ready to go. Velcro cable ties make cable-tying brilliantly simple and there's loads of room for excess wiring in the PSU area, as well as a decent amount of room behind the motherboard tray.

Initial cooling results aren't great though. Even at maximum fan speed, we only saw a CPU delta T of 65°C, which is very warm, although 54°C for the GPU isn't too bad. However, the roof dust filters make it feasible to open up this area, which instantly knocks 7°C off the CPU temperature – it still isn't an amazing result, but it's healthy enough. Noise does increase with the roof open, but you can then use lower fan speeds too.

Conclusion

For £55, the P400S offers great value for money. It punches above its weight in terms of looks and quality, the ease of use is outstanding and the expansion options are solid – it's easily your best bet for a budget of around £50. If high airflow performance or flexible room for water-cooling gear are priorities, though, the Define S is worth the extra outlay.

COOLING	FEATURES	OVERALL SCORE
25/30	15/20	86%
DESIGN	**VALUE**	
27/30	19/20	

VERDICT

A well-made and user-friendly chassis with an impressively tidy interior for a great price, although your CPU can get hot if you don't use the roof vents.

/SPECIFICATIONS

Dimensions (mm) 210 x 470 x 465 (W x D x H)
Material Steel, plastic
Available colours Black, gunmetal grey, white
Weight 7kg
Front panel Power, reset, 2 x USB 3, headphone, mic
Drive bays 2 x 3.5in/2.5in, 2 x 2.5in (4 x 3.5in/2.5in available via optional brackets)
Form factor(s) E-ATX, ATX, micro-ATX, mini-ITX
Cooling 2 x 140mm or 3 x 120mm front fan mounts (1 x 120mm fan included), 1 x 120mm rear fan mount (120mm fan included), 2 x 140mm/120mm roof fan mounts
CPU cooler clearance 170mm
Maximum graphics card length 395mm
Extras Removable dust filters, fan controller

SilverStone Redline RL05 / Approx £55 inc VAT

SUPPLIER TBC

SilverStone's brand new RL05 aims to bring modern design to a low price. In terms of build quality, it's similar to In Win's 503 (see p48) – you can tell it uses thin, less expensive steel but it's still fairly robust and uses minimal plastic. That said, its feet are made from plastic, without any rubber or foam on which to stand.

Behind the mesh-heavy front sit two 140mm red LED intake fans – the only fans supplied. This setup forms a positive pressure design, forcing air to exhaust naturally through the rear and roof vents. A cool feature is the USB Type-C connector, although it runs at standard USB 3 speeds, due to the lack of USB 3.1 internal headers. However, the power and reset buttons down the side feel stiff, shallow and cheap.

Dust filters are provided for the roof, front and PSU areas, although the filters are thin sheets that are fiddly to remove, and are even fiddlier to get back into place. Furthermore, the roof filter has to be removed from inside the case.

Meanwhile, the left panel sports a large, clear window while the roof and right panels are simply made from flat steel. Accessing the case isn't great though – notches and rails are used for the side panels, and when pulling off the front, you end up bringing the I/O cables with you. On the plus side, the internal design has a number of modern elements, such as the full-length PSU cover (non-removable) with a cable-routing hole cut into it. There's also minimal airflow interference, with just a single 5.25in drive bay in the main cavity, which doesn't impede the fans.

The 5.25in bay uses tool-free installation and you also get a pair of 2.5in mounts behind the motherboard tray, which can be moved into the main chamber to display your SSD on the PSU cover if desired. There's also a removable 3.5in/2.5in cage with two drive trays in the lower section. This cage's trays are plastic and a little flimsy, but functional and tool-free if you're installing 3.5in drives. In addition, an 80mm fan can be installed in front of the cage for direct hard drive cooling.

If you want to install water-cooing gear, the upper two fan mounts support 280mm radiators but, oddly, not 240mm ones. Clearance is low, however, so even a slim radiator with one bank of fans could be problematic. At the front, both 240mm and 280mm radiators are supported without removing any parts, although the 5.25in drive cage can be removed if necessary. Thick radiators should be fine here – you'll eat into graphics card clearance, but that's already pretty generous.

Meanwhile, the cable-routing column at the front, as well as the PSU cover, go a long way to hiding cables, and all of the case's I/O cables are black. It's quite tight behind the motherboard, though, and there are no grommets on the routing holes.

The cable-routing system is functional but not as advanced or easy to use as those of Fractal Design or Phanteks.

SilverStone typically excels at cooling, though, and the RL05 doesn't break that mould, with excellent delta T results of 54°C and 50°C for the CPU and GPU respectively. The chassis is a touch loud, which isn't surprising giving its porous exterior.

Conclusion

The RL05 has a number of similarities to the Phanteks P400S, most notably the price and modernised layout. The RL05 wins on cooling, and the inclusion of USB Type-C is neat, but the Phanteks wins out on build quality and user experience. The RL05 is worth considering if you're looking for top cooling on a budget, but most people will be better served by the Phanteks P400S at this price.

COOLING	FEATURES	OVERALL SCORE
28/30	14/20	79%
DESIGN	VALUE	
20/30	17/20	

VERDICT

Combines great cooling with modern touches, such as a PSU cover and USB Type-C connector, but the RL05 falls down on build quality and ease of use.

/SPECIFICATIONS

Dimensions (mm) 210 x 450 x 465 (W x D x H)
Material Steel, plastic
Available colours Black
Weight 5.5kg
Front panel Power, reset, 1 x USB 3 Type-C, 2 x USB 3, headphone, mic
Drive bays 1 x 5.25in, 2 x 3.5in/2.5in, 2 x 2.5in
Form factor(s) ATX, micro-ATX, mini-ITX
Cooling 2 x 140mm/120mm and 1 x 80mm front fan mounts (2 x 120mm fans included), 1 x 120mm rear fan mount, 2 x 140mm/120mm roof fan mounts
CPU cooler clearance 165mm
Maximum graphics card length 373mm
Extras Removable dust filters

Thermaltake Versa N21 / £35 inc VAT

SUPPLIER www.scan.co.uk

Thermaltake's Versa N21 will set you back just £35, making it the least expensive chassis on test. The construction quality, while not awful, is the least impressive of the bunch, though, with lots of glossy and reflective plastic used on the bulky top and front, which feels cheap and easily picks up marks. It's translucent, so LED fans should look good through it at least.

Whereas most cases here have dual USB 3 ports as standard, the Versa N21 is limited to one, but that's still better than zero with the price in mind. The rear 120mm fan mount is the only one that's filled as well, leaving four more empty, and there's understandably no fan controller either. What you do get, thankfully, is full dust filter coverage. The filters are only flimsy bits of material, and getting them on and off the case can be fiddly, but it's better than a dusty PC.

Meanwhile, the side panels are attached with thumbscrews, notches and rails, and don't even have any handles. The front panel can be tugged off fairly easily, and comes away cleanly from the case, but the roof will drag up all the I/O cables with it, potentially ruining your tidy build. Inside, six motherboard standoffs are pre-installed, and the cables are neatly sleeved in black. The power supply is also partially isolated from the chassis by some small foam pads.

Unlike some cases in this Labs test, the N21 retains optical drive support, with the top cage offering room for a single externally accessible 5.25in drive. It uses tool-free clips and drive access comes via the door that makes up the top half of the front panel. There's also a 3.5in/2.5in mount in this cage with external 3.5in access.

The main drive cage sits at the bottom of the case, featuring three 3.5in/2.5in mounting trays. These trays are tool-free for 3.5in devices but the bays are flimsy and have no anti-vibration measures. On the plus side, the space between the hard drive cage and the optical drive cage ensures support for extra long graphics cards. The final internal drive mount is the singular, dedicated 2.5in drive tray fixed to the rear of the motherboard tray.

There are no rubber grommets in the Versa N21, but this case's cable management isn't bad. There are numerous holes, mostly in helpful locations, and the extruded side panel means you have plenty of space for hiding cables. It's as good as you could reasonably expect from a £35 case. The roof fan mounts can also accommodate a water-cooling radiator, but you'll be lucky to fit anything beyond a slim all-in-one liquid cooler with a single row of fans.

That single 120mm fan isn't really enough to cool components adequately either. The best it manages for the CPU is a delta T of 60°C, the joint worst result. It's the GPU, however, that gets really toasty, peaking at a delta of 62°C – only the Anidees AI-07BW with its fans off and the Phanteks Eclipse P400S at minimum speed managed worse outcomes.

Conclusion

The Thermaltake Versa N21 isn't a spectacular case, but it does cover most of the basics for a very low price. Core features such as USB 3 support, dust filters, and dedicated SSD mounting points are all present, and while it lacks more advanced usability features found elsewhere in this Labs test, the Versa N21 doesn't hinder your build. Still, relative to other cases on test, it struggles in more than one area. If you can save £20 more for the Phanteks Eclipse P400S, you'll be well rewarded for the extra investment.

COOLING	FEATURES	OVERALL SCORE
20/30	11/20	67%
DESIGN	**VALUE**	
18/30	18/20	

VERDICT

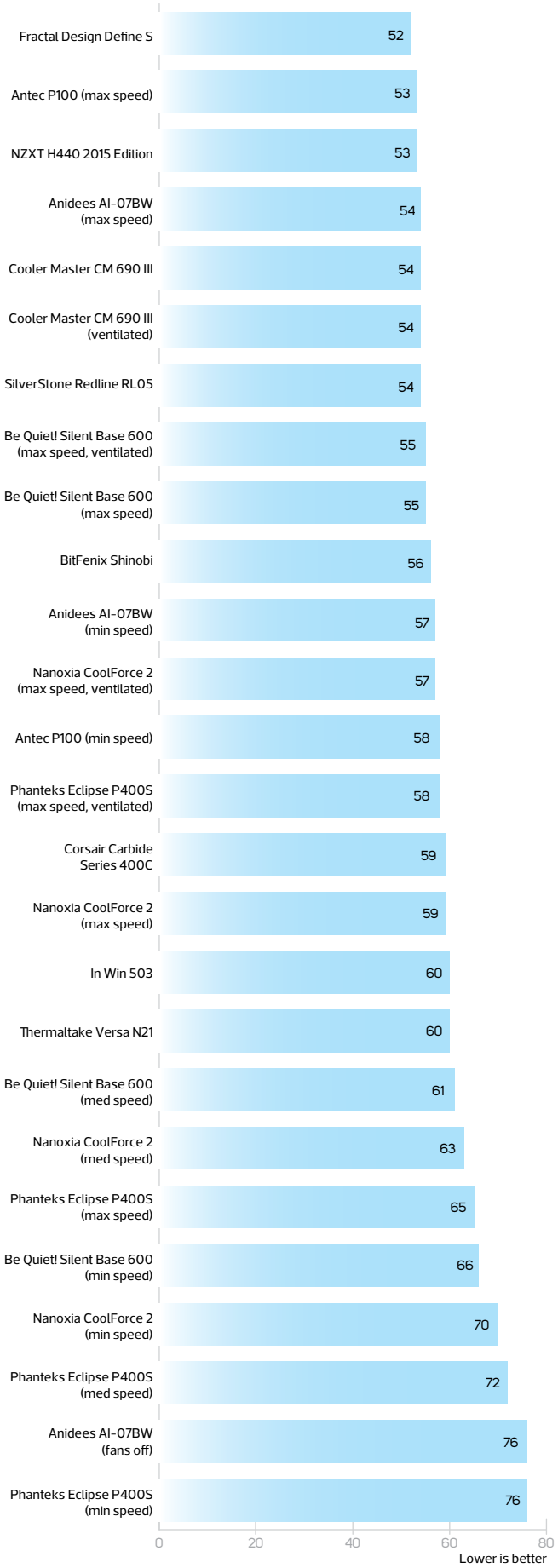
The Versa N21 covers all the basics for a very low price, but it struggles next to cases that cost only £15-20 more – that extra cash is definitely worth spending.

/ SPECIFICATIONS

Dimensions (mm) 217 x 463 x 513 (W x D x H)
Material Steel, plastic
Available colours Black, white
Weight 4.6kg
Front panel Power, reset, 1 x USB 3, 2 x USB 2, headphone, mic
Drive bays 1 x 5.25in, 4 x 3.5in/2.5in, 1 x 2.5in
Form factor(s) ATX, micro-ATX, mini-ITX
Cooling 2 x 120mm front fan mounts, 1 x 120mm rear fan mount (fan included), 2 x 120mm roof fan mounts
CPU cooler clearance 160mm
Maximum graphics card length 360mm
Extras Removable dust filters

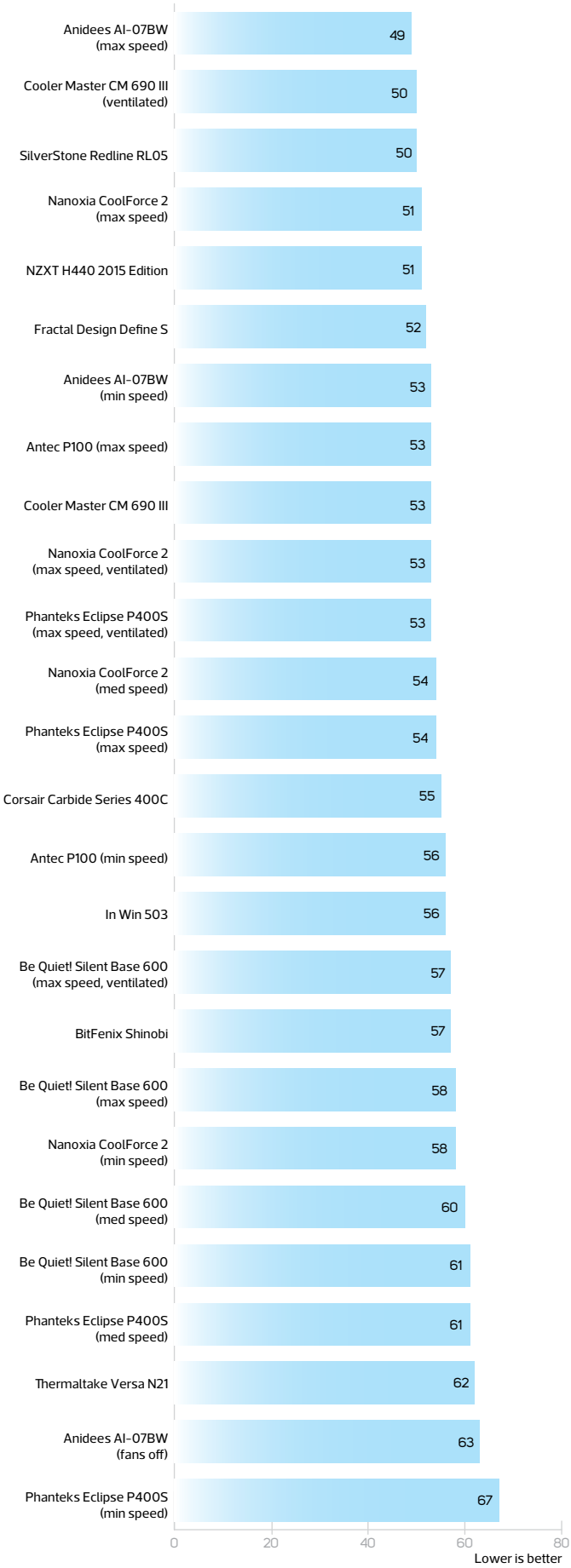
CPU DELTA T

Difference between CPU temperature and ambient temperature (°C)



GPU DELTA T

Difference between CPU temperature and ambient temperature (°C)



PC system reviews

GAMING PC

Overclockers 8Pack Asteroid / £3,990 inc VAT

SUPPLIER www.overclockers.co.uk

Overclockers and Parvum have created something rather special with the latest 8Pack system, the Asteroid, a very high-end mini-ITX rig with a gorgeous custom water-cooling loop. Even its case isn't available off the shelf, and was instead custom-designed by Parvum Systems and Overclockers' resident overclocker and high-end system builder 8Pack.

It's a mini-ITX case, but it's much larger than Parvum's standard mini-ITX cases in all directions, for a couple of good reasons. The Asteroid's specification requires at least a double 120mm-fan radiator to cool its hardware, but Overclockers wanted to keep noise to a minimum so it worked with Parvum Systems to create a case that can house two EKWB CoolStream SE 240 radiators. They're located in the base of the case, thanks to the Asteroid's dual-chamber design, with the PSU, pump and storage hidden out of sight.

The radiators exhaust air out of the bottom of the case, aided by one of the front fans and fed by large vents next to them in the base of the case. The two intake fans draw air into the chassis, but there isn't anywhere for most of this air to go. In an air-cooled system, this situation would be disastrous, as the heat would just build up inside, but the fact that the radiators are separated from the rest of the PC means the interior remains relatively cool. Even so, we'd like to have seen some additional vents, or even an exhaust fan. What's more, none of the fans is equipped with dust filters. All this is possible with a Parvum case, as we saw with Chillblast's Batman-inspired Arkham Knight Dream Edition (see Issue 145, p41).

The Asteroid uses triple layers of acrylic, rather than the usual two layers you see in Parvum's off-the-shelf cases, which enables OCUK to create a fantastic contrast between frosted clear, black and red sheets. The benefits aren't only aesthetic either – the case also feels remarkably sturdy as a result, which is just as well, as the case has been modified from head to toe. To start, the roof has a large window that provides a spectacular view to the graphics card. As the motherboard is inverted, the GPU waterblock is on show, so you can see the coolant passing through it.

One of the centrepieces of the Asteroid, though, is the reservoir. It's built into the case roof, thanks to a recess that's been milled out next to the roof window. It isn't just for show either – it's a fully functioning reservoir with a fill port, and it looks fantastic. Meanwhile, the front section sports a figure-of-eight insert above the two fan grilles, and there's another reminder of 8Pack's involvement with the Asteroid's star attraction – the water cooling pass-through plate in the centre of the chassis.

Having coolant pass through a PSU cover or mid-section plate isn't uncommon, but the difference in this case is that channels have been milled out of the sandwiched sections of acrylic to allow the coolant to flow within it, running from one barb fitting to another, around the case. It's an outstanding design, and the work involved is deceptive, thanks to the clean-looking interior. Once you add the use of straight acrylic tubing and red Mayhems coolant, the Asteroid is one of the most customised, distinctive and jaw-dropping PCs we've reviewed.

The cooling system also includes a Laing DDC pump with an EK aftermarket high-performance top, which is nestled next to the PSU in the rear chamber. There's also an Aquacomputer Aquaero fan controller, which actively controls the fans and enables you to tweak the fan speeds and profiles in Windows.

Out of the box, the Asteroid is blissfully quiet. In fact, you have to pin your ear against the case to tell if it's switched on. It only becomes audible in games or stress testing.

/SPECIFICATIONS

CPU Intel Core i7-6700K overclocked to 4.8GHz

Motherboard Asus Maximus VIII Impact

Memory 8GB Team Group Xtreem 3866MHz DDR4

Graphics Nvidia GeForce GTX 980 Ti 6GB

Storage 512GB Samsung Evo 850, 1TB Samsung Evo 850

Case Parvum Systems custom design

Cooling EK Supremacy Evo CPU waterblock, EK FC Titan X GPU waterblock, Laing DDC pump with EK top, custom reservoirs, 2 x EK CoolStream SE 240 radiators, 6 x 120mm SilverStone OCUK Watercooling fans, Mayhems Red Pastel coolant, EK fittings, EK acrylic tubing

PSU SuperFlower Leadex Titanium 1000W

Ports Rear: 4 x USB 3, 1 x USB 3.1 Type-A, 1 x USB 3.1 Type-C, 2 x Gigabit Ethernet, 3 x audio

Operating system Windows 10 64-bit

Warranty Three years collect and return parts and labour, followed by two years labour only return to base

ELITE
NEW ENTRY
P64

1 **The custom reservoir is built into the case's roof**

2 **The custom water cooling pass-through plate is the star attraction**

3 **The custom pass-through plate means straight tubing can be used**

Overclockers has carefully tweaked the SilverStone fans in the Asteroid; when combined with plenty of radiator capacity, these result in a super-quiet system that's able to tame its hardware with a minimum of noise.

The CPU and GPU waterblocks are both made by EKWB, as is the acrylic tubing and fittings. Rather than bending the tubing, which would massively increase the system build time, OCUK has instead used straight sections. Thanks to the custom reservoir and pass-through section, the blocks could be placed in exactly the right locations in order to have straight linking tubes. In any event, the interior, combined with some subtle white lighting, neat cable tidying, and red, black and grey-sleeved cables, is absolutely stunning.

The hardware may come as a bit of a surprise, though, given that we're dealing with a PC that costs nearly £4,000. After all, you'd be right to expect a multi-GPU, X99-based water-cooled system for the same money if you bought an ATX system. However, Overclockers UK has instead opted for an Intel Skylake setup using the obvious choice for such a build – Asus' Maximus VIII Impact. There was another option here in the form of ASRock's X99E-ITX/ac, which would at least have allowed for a 6-core CPU to justify the price, especially given that the Core i7-6700K is only a little cheaper than the Core i7-5820K.

However, Overclockers UK does have some reasoning behind this decision. Haswell-E CPUs often haven't proved to be great overclockers, with 4.4GHz often being the limit for a 24/7 overclock on a Core i7-5820K. The Core i7-6700K, on the other hand, fares much better and, thanks to some extensive and time-consuming speed-binning on the part of 8Pack for his exclusive systems, the Asteroid's CPU runs at a whopping frequency of 4.8GHz. Seeing as two additional cores would only be of use in tasks such as 3D rendering, you could safely argue that, for everything else, especially gaming, a heavily overclocked Core i7-6700K is a better option.

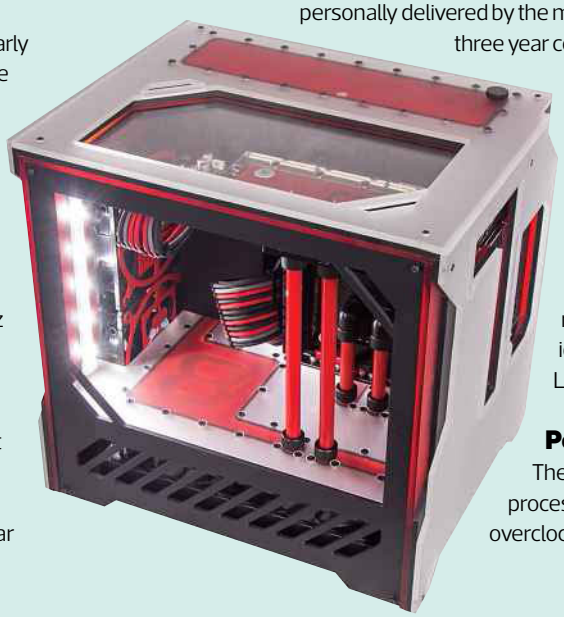
Overclockers UK has also clearly listened to our concerns over the use of Nvidia's Titan X, even in extremely expensive PCs, and has instead opted for a GTX 980 Ti card. It's been significantly tweaked too, with the core overclocked to 1250MHz, and the memory running at 1900MHz (7600MHz effective), with 22mV added to the GPU core's voltage.

The memory initially took us by surprise though – there's just 8GB of RAM in the system. However, we rarely see more than 5-6GB being used in regular computing tasks, even while gaming, so it isn't really a deal breaker unless you run a lot of virtual machines, or use a lot of RAM for a specific task, in which case you can upgrade to 16GB for around £100. However, Overclockers UK hasn't used just any memory. The Team Group Xtreem modules run at a super-high frequency 3866MHz.

Meanwhile, the storage arrangement is sensible rather than lustworthy; a 512GB Samsung Evo SSD is used for the OS and a second 1TB model is included to house games, data and programs. Having 1.5TB of solid state storage space certainly sounds great, but at this price, we'd have liked to see a faster drive, such as Samsung's 950 Pro, for the OS drive – an omission that's a result of the lack of an M.2 connector on the Maximus VIII Impact. Still, Overclockers has at least managed to banish hard disks from the Asteroid, which aids its low noise levels.

Being an 8Pack system, the Asteroid also comes personally delivered by the man himself and includes a three year collect and return warranty that covers both parts and labour warranty, where 8Pack will be at your beck and call.

A further two years of labour is included too. In addition, the system arrives in a very sturdy flight case that's had its innards custom-made to fit the Asteroid, and is ideal for transporting the PC to LAN events.



Performance

The combination of massive processor and graphics card overclocks, combined with the



Asteroid's water-cooling system, saw some fantastically fast benchmark results. Its system score of 156,031 is on a par with the maximum scores we usually see in overclocked motherboard results – amazing for a machine designed to run 24/7. Similarly, the only time the Asteroid dipped below 40fps in games was in Crysis at 4K – all the other results were silky-smooth and the 33fps minimum in Crysis 4 at 4K is still fine.

The second radiator clearly helped to achieve some great cooling numbers too. Under load, the CPU never topped 80°C with an ambient temperature of 24°C, and the GPU was a long way from throttling, sitting at just 45°C or below in games. Meanwhile, the SSDs performed as expected, with read and write speeds well above 500MB/sec.

Conclusion

By far the biggest selling point of the Overclockers 8Pack Asteroid is its eye candy. It looks fantastic, although you're clearly paying a hefty premium for the extra work that's gone in to creating a unique-looking PC. It wouldn't look out of place in line-ups of world-class PC mods, or the Dream PCs we have in our Labs, and in our minds, that's worth the cost if you have that kind of cash at your disposal.

The cooling system is potent too, making the Asteroid one of the quietest PCs we've ever tested, despite its incredible performance.

A few of the hardware choices are perhaps the only areas of concern. Despite costing the best part of four grand, there's no 6-core or 8-core CPU, only 8GB of RAM and no super-fast, next-gen storage, but it's still more than capable of handling games at 4K. If you want one of the most customised PCs available today, though, and your priorities are low noise, great looks, fast gaming performance and a small chassis, your choices don't come much better than the Asteroid.

ANTONY LEATHER

CPC REALBENCH 2015

GIMP IMAGE EDITING

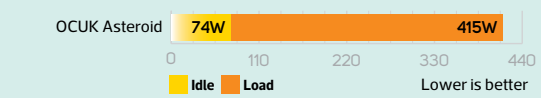
HANDBRAKE H.264 VIDEO ENCODING

HEAVY MULTITASKING

SYSTEM SCORE

INTEL REFERENCE: 136.33%

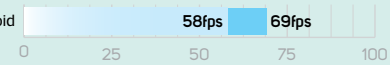
TOTAL SYSTEM POWER CONSUMPTION



FALLOUT 4

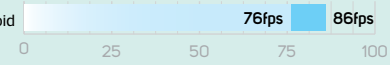
3,840 x 2,160, High Detail, TAA

2,560 x 1,440, Ultra Detail, TAA

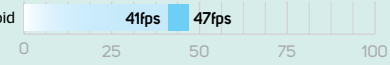


THE WITCHER 3: WILD HUNT

2,560 x 1,440, High settings, HairWorks off

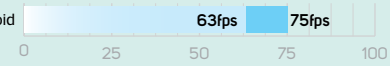


3,840 x 2,160, High settings, HairWorks off

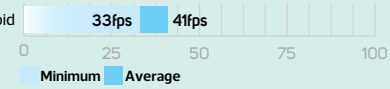


CRYSIS 3

2,560 x 1,440, Very High settings, 0x AA



3,840 x 2,160, Very high settings, 0x AA



SPEED	DESIGN	OVERALL SCORE
23/25	33/35	85%
HARDWARE	VALUE	
19/25	10/15	

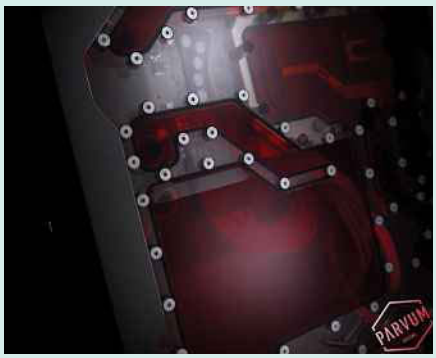
VERDICT

The Asteroid's price stems from epic customisation that's simply eye-popping. It's fast and super-quiet too, but it lacks some of the hardware you'd expect for this price.

INTERVIEW

Parvum Systems

Fancy getting your own custom Parvum case? Antony Leather catches up with Parvum Systems designer, Joe Robey, to discuss customisation options



CPC: What custom Parvum cases have you made that aren't currently available off the shelf?
Parvum: We've produced several game-themed cases for Nvidia's 'share every win' giveaways, and for modders and customers around the world. Not all themed cases are inspired by games; some have been designed in response to PC hardware releases, films, sports teams or notable brands. Modders have typically received not only aesthetically revised cases, but also new layouts and designs, such as jameswalt1's vertically orientated ITX Parvum Warfare case, and MunneY's double wide mATX eNVy, which has a reservoir integrated into the midwall.

CPC: What customisations have you made to your cases for customers?
Parvum: The most common modifications are the additions of clan names or logos in the form of window etchings and inlays, inverted or uninverted motherboard layouts and extensions to accommodate further water-cooling gear, such as getting a 360mm radiator into the S2.5. On occasion, we've also made adjustments to allow for larger air-cooling components, such as tall CPU coolers or wide graphics cards, and the addition or removal of holes to allow for cleaner routing of tubing and cables in specific builds.

CPC: How many colours do you currently offer for your cases?
Parvum: Each case on our website is listed with over 30 colour options using matt, frosted, gloss, metallic and fluorescent finish acrylics. We're always listening to requests for different combinations, so just let us know if you have a unique idea for your case. Additionally, accent packs are always available should you wish to change the scheme of your build as new hardware comes along.

CPC: Have you customised any other manufacturers' cases? What materials can you work with?
Parvum: Yes, we made extensive modifications to an ASRock M8 case here, removing most of the internals and fabricating a new motherboard tray and PSU mount, along with a hugely elaborate monoblock.

While it's easier for us to work with our own products, we do enjoy the occasional challenge to maintain our perspective and explore different approaches.

We've also helped modders to fabricate parts such as internal mounting plates, custom reservoirs and exterior panels for their own projects, using CaseLabs, In Win and Hex Gear cases, as well as scratch builds. Our machinery and tooling is specialised for sheet materials, predominantly cast acrylic, but also acetal, aluminium, brass and copper when required.

CPC: How can customers get their cases modified? Can they just send drawings or do they need design experience?
Parvum: Some of our most successful custom cases have started from a simple sketch or MS Paint drawing!

However, while design experience isn't necessary, the ability to communicate your requirements and an understanding of our limitations is essential.

CPC: How much would a custom Parvum case, such as the Asteroid, cost as a one-off?
Parvum: Producing a case as complex as 8Pack's Asteroid as a one-off really isn't feasible; the case was designed at the same time as the water-cooling loop, making it specific to that hardware. A significant amount of time was invested into producing the first Asteroid, which we've previously only done for our show builds – we're extremely proud to have made that level of system available to end users through 8Pack.

CPC: How much do you charge for simpler customisations?
Parvum: Simple customisations to our cases, such as removal of fan mounts or a unique colour combination, can be free of charge. Reverse window etching and acrylic inlaying to one panel cost £17.99 and £53.99 inc VAT respectively. Full themed cases and custom layouts vary in cost depending on the extent of the required changes.

GAMING PC

CyberPower Infinity X55 Pro / £999 inc VAT

SUPPLIER www.cyberpowersystem.co.uk

The Infinity X55 Pro might be a sub-£1,000 system, but it makes a first impression we expect from far pricier machines. That's because CyberPower has deployed Corsair's vast Carbide 600C case, and has filled the black interior with bright white lights.

The Carbide 600C isn't just striking because of its size. The motherboard also sits upside down, on the opposite side of the chassis from usual. The CPU is at the bottom of the case, with the GPU above it, and a shroud at the very top hides the PSU, its cables and most of the storage. Corsair says the odd layout is designed to improve airflow thanks to a clearer route to the main components. And, despite the unconventional design, it's a popular chassis – PC Specialist chose the same case for its Vanquish Redline (see Issue 153, p60), which cost £979.

Corsair's design and CyberPower's neat building makes for a tidy rig. The main power cables emerge discreetly from rubber-lined routing holes, and the smaller cables at the bottom of the board are barely visible. It isn't neat around the back, with cables roughly bunched together, but it's serviceable and you won't see this area in everyday use.

The tidy build and the sheer size of the Carbide 600C means it's easy to work inside the CyberPower too. There's ample room around the motherboard slots, and the Corsair H55 cooler doesn't intrude on the two empty memory slots. There are two empty SSD bays around the back as well, plus one free hard disk bay. The case is good-looking but, as with the Carbide 400C (see p45), build quality could be better in a couple of places. The metal frame beneath the plastic is rock-solid, but the interior shroud and some of the drives bays are all a little flimsy.

Inside, there's a Core i5-6600K, which has four cores but no Hyper-Threading and a smaller cache than Core i7 chips. It's the same CPU used in the aforementioned PC Specialist rig, and both machines share an overclock from 3.5GHz to 4.6GHz. There's little to choose between the systems in terms of storage either. CyberPower's machine has a 240GB Corsair Neutron XT SSD and a 1TB hard disk, whereas the PC Specialist had a 240GB Kingston HyperX Savage boot drive.

The Infinity diverges from its rival elsewhere though. It has 8GB of 2400MHz memory, while the Vanquish Redline had 16GB of 2133MHz RAM. More importantly, the two machines have different GPUs. The Infinity sports an overclocked XFX Radeon R9 390 – a significant step up from the XFX R9 380X in the PC Specialist machine, which should result in playable frame rates at 2,560 x 1,440. The R9 390 has a reputation for hot running, though, so it will be interesting to see how the Carbide 600C's airflow helps in this respect. The other key area where the two machines differ is CPU cooling – the CyberPower has a single-fan 120mm Corsair H55 cooler, compared with the two-fan, 240mm Corsair H100i cooler in the PC Specialist, although the latter is arguably overkill for a Core i5-6600K chip.

Meanwhile, the MSI motherboard is a no-nonsense slab of black PCB with a good basic feature set, including support for multi-GPU setups, an M.2 socket, beefed-up audio circuits and a trio of diagnostic LEDs. Those latter two features lift it above the Asus board installed in the PC Specialist, but there's nothing to choose between the two at the rear: both have pairs of USB 3 and USB 2 ports, a single USB 3.1 Type-C connector, and six audio jacks and standard Gigabit Ethernet.

Finally, CyberPower's standard warranty offers two years of the all important parts and labour coverage, with a further year of labour only cover.

There's only a month of collect and return service though – afterwards, it reverts to a return to base deal. It's still better the PC Specialist machine's warranty, however, which only had a single year of parts coverage.

Performance

The CyberPower's overclocked Core i5 processor delivered solid benchmark results, although the PC Specialist was a little quicker in our RealBench 2015 suite, with its final result of 118,269 being about 3,000 points behind its rival. The CyberPower is slower, then, but there's not much in it – and no games or applications will noticeably struggle as a result More significantly, the CyberPower's came back strongly in

/SPECIFICATIONS

CPU 3.5GHz Intel Core i5-6600K overclocked to 4.6GHz

Motherboard MSI Z170A SLI

Memory 8GB 2400MHz Corsair Vengeance LPX DDR4

Graphics XFX AMD Radeon R9 390

Storage 240GB Corsair Neutron XT SSD; 1TB hard disk

Case Corsair Carbide 600C

Cooling CPU: Corsair Hydro H55 with 1 x 120mm fan; GPU: 2 x 90mm fans; front: 2 x 140mm fans

PSU Corsair VS650 650W

Ports Front: 2 x USB 3, 2 x USB 2, 2 x audio; rear: 2 x USB 3, 2 x USB 2, 2 x PS/2, 1 x USB 3.1 Type-C, 1 x Gigabit Ethernet, 6 x audio

Operating system Microsoft Windows 10 Home 64-bit

Warranty Two years parts and labour, plus one year labour only. One month collect and return, then return to base

the games benchmarks, where its overclocked R9 390 overpowered the tweaked R9 380X in the PC Specialist rig.

Not surprisingly, the Infinity had no problems with 1080p gaming but, unlike the PC Specialist, it also managed playable fame rates in all our test games at 2,560 x 1,440, never dropping below 30fps, even in tough tests such as Crysis 3 and Fallout 4.

The two machines converged again in storage benchmarks though. The Corsair Neutron SSD's sequential read speed of 526MB/sec is barely ahead of the PC Specialist's Kingston drive, and the Neutron's 429MB/sec write pace is a little behind. They're all solid scores for SATA drives, but that M.2 slot could deliver a much quicker pace if it's used in the future.

There wasn't much to choose between the systems in thermal and noise tests either. The CyberPower's CPU and GPU delta Ts of 47°C and 52°C are both a little higher than the PC Specialist, but the latter is no surprise given the GPU used, and neither is cause for concern. The Infinity kept quiet throughout our tests too, with barely any additional noise during stress tests. As such, the Carbide 600C's lowest fan speed can be used without any negative repercussions.

Conclusion

The CyberPower's mid-range specification is better balanced than its rival from PC Specialist. It might not have as much memory, or the large CPU cooler, but those differences have much less of an impact than the tweaked Radeon R9 390 in the Infinity, which is noticeably quicker than the R9 380X in the Vanquish Redline, enabling gaming at 2,560 x 1,440, and both systems have capable Core i5 processors.

The large Carbide 600C case is perhaps overkill for the CyberPower's mid-range hardware, but it also means it's kept cool without making too much noise. If you're looking for a well-built PC for gaming at 1080p or 2,560 x 1,440, the Infinity X55 Pro gives you a good system for a fair price.

MIKE JENNINGS

1. **The Carbide 600C positions the motherboard upside down, with the PSU at the top**
2. **The XFX Radeon R9 390 graphics card makes gaming at 2,560 x 1,440 possible**
3. **The overclocked CPU is kept in check by a Corsair H55 all-in-one liquid cooler**

CPC REALBENCH 2015

GIMP IMAGE EDITING

HANDBRAKE H.264 VIDEO ENCODING

LUXMARK OPENCL

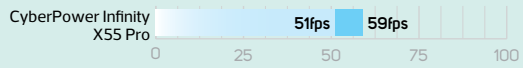
HEAVY MULTITASKING

SYSTEM SCORE

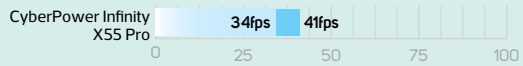
INTEL REFERENCE: 103.33%

FALLOUT 4

1,920 x 1,080, Ultra Detail, TAA

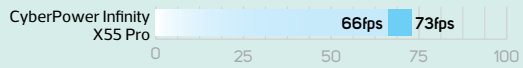


2,560 x 1,440, Ultra Detail, TAA

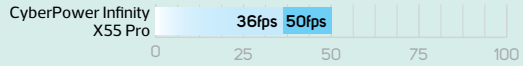


WITCHER 3

1,920 x 1,080, High Detail, AA on

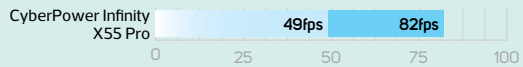


2,560 x 1,440, High Detail, AA on

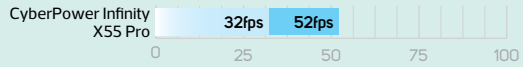


CRYSIS 3

1,920 x 1,080, Very High Detail, 0x AA



2,560 x 1,440, Very High Detail, 0x AA



Minimum Average

SPEED	DESIGN	OVERALL SCORE
20/25	21/25	83%
HARDWARE	VALUE	
21/25	21/25	

VERDICT

A well-built and well-balanced system that offers 2,560 x 1,440 gaming for under a grand.

GAMING PC

Box Cube Oblivion / £1,850 inc VAT

SUPPLIER www.box.co.uk

The Box Cube Oblivion is an expensive rig filled with high-end hardware, so it makes sense that it's all packed into Corsair's Carbide 760T – a big bruiser of a chassis. It has two wide, hinged side panels that open with sturdy handles, while its two front-mounted 140mm fans glow through the meshed façade with white LEDs. The panels are black and subtle, with a matt finish, and a vast window on one of the side panels opens up the interior for inspection.

The size of the Carbide 760T means there's loads of room on the inside. There's so much space in the roof that the Corsair Hydro H110i cooler and its two 140mm fans are barely visible, and the chunky Corsair HX750i modular PSU is similarly hidden at the bottom of the enclosure.

There's also ample room around the motherboard, which is ringed with rubber-coated cable-routing holes, and plenty of space at the front of the case for additional hardware. The 760T's huge size means working inside the Oblivion is a cinch, and there's plenty of room to grow too. There are two hard disk bays at the bottom, with five spare 3.5in bays and four 2.5in bays free behind the rear side panel.

Only one of the 760T's upgrade paths is blocked, but with good reason: Box has filled the two spare 5.25in bays with an Asus Republic of Gamers Front Base. It's a futuristic-looking unit that presents plenty of information across a trio of dials on a 4in display: clock speeds, case and component temperatures and fan speeds are all available.

The unit also offers a fast-charging USB port, five different audio equaliser modes and a button to turn off the lighting. However, while it undoubtedly looks good in the front of this PC, it isn't an essential – most of that information can be displayed in a more accessible way on the Windows desktop.

Our only slight quibble is with cabling. The wires are reasonably tidy around the front, but they don't run in the regimented lines we're used to seeing in machines from the likes of Scan, and they're even more of a mess around the back. None of the cabling is sleeved either.

The big, imposing chassis is filled with impressive hardware though. Graphics power comes from an Asus Strix GeForce GTX 980 card, which ups the Nvidia GPU's standard speed from 1126MHz to 1178MHz with a mighty 1,279MHz boost clock.

Meanwhile, the familiar Core i7-6700K has been tweaked from 4GHz to 4.7GHz, and it's deployed alongside a whopping 32GB of 3000MHz DDR4 memory – great if you run lots of virtual machines, or run very memory-intensive software, but overkill for most computing jobs, including games.

/SPECIFICATIONS

CPU 4GHz Intel Core i7-6700K overclocked to 4.7GHz

Motherboard Asus Maximus VIII Hero

Memory 32GB Corsair Vengeance LPX 3000MHz DDR4

Graphics Asus GeForce GTX 980 4GB

Storage 256GB Samsung 950 Pro M.2 SSD, 2TB Seagate hybrid hard disk

Case Corsair Graphite 760T V2

Cooling CPU: Corsair Hydro H110i with 2 x 140mm fans; GPU: 2 x 90mm fans; front: 2 x 140mm fans; rear: 1 x 140mm fan

PSU Corsair HX750i 750W

Ports Front: 2 x USB 3, 2 x USB 2, 2 x audio; rear: 2 x USB 3, 1 x USB 3.1 Type-A, 1 x USB 3.1 Type-C, 4 x USB 2, 1 x PS/2, 1 x Gigabit Ethernet, 1 x optical S/PDIF, 5 x audio

Operating system Microsoft Windows 10 Home 64-bit

Warranty Two years parts and labour, with one year collect and return and one year return to base

The boot drive is a 256GB Samsung 950 Pro SSD, which uses the motherboard's M.2 connector to fully exploit 4x PCI-E 3 bandwidth. There's also a 2TB hard drive for data storage. The motherboard is a cut above the competition too. The Asus Maximus VIII Hero is a superb high-end motherboard, and it's littered with chunky grey and red heatsinks that have customisable lights, and its bottom edge is covered with buttons and connectors, all of which are easily accessible thanks to the size of the case.

The board has two spare 16x PCI-E slots, three empty 1x PCI-E slots and numerous empty SATA ports, plus it has Asus' SupremeFX audio system, Asus' excellent Asus UEFI BIOS and several handy features, such as SSD secure erase, Internet BIOS flashing from within the EFI and useful features such as USB BIOS Flashback and CrashFree BIOS are handy too.

Finally, the Cube sports a two year parts and labour warranty, including a year of collect and return coverage.

Performance

The Cube's overclocked Core i7 scored 70,187 in our image editing test, which responds well to high clock speed, and is a great result, helped along by the Hero motherboard's excellent performance. The Box's overall score of 150,958 is also excellent. However, the Cube Oblivion's comparative lack of graphical power hurts it in games.

The GTX 980 is a fine GPU, of course, and the Cube Oblivion never dropped below 40fps in any of our game tests at 2,560 x 1,440. However, the GTX 980 runs out of steam once you hit 4K, where the Box's minimum frame rate was below 30fps in all our tests – only The Witcher 3 is borderline playable at this resolution. Comparatively, Scan's 3XS Z170 Vengeance Ti (see Issue 153, p58) has a GTX 980 Ti card that can cope with borderline 4K gaming in all our game tests, while offering the same CPU and overclock as the Box for £250 less. The Box has a better motherboard,

1 **Windows is installed on a super-fast M.2 Samsung 950 Pro**

2 **The Asus GTX 980 is great for 2,560 x 1,440 gaming**

3 **A whopping total of 32GB of 3000MHz RAM is installed**

more memory, an M.2 SSD, a snazzy front panel and a liquid cooler over the Scan, but it needs a better GPU at this price.

The Box gains some ground in storage tests. The M.2 Samsung drive rattled through our sequential read and write tests at 2,067MB/sec and 1,254MB/sec respectively, and both results are several times faster than the SATA drives.

The Cube's thermal performance is fine too, with CPU and GPU delta Ts of 61°C and 40°C respectively. However, while the noise output is barely audible when not running games, the fans spin up after a few minutes of gaming, and then modulate the tone up and down. During particularly intense moments, the Box sounds like a car changing gears, which can be off-putting if you're not using loud speakers or a good headset. Comparatively, the aforementioned Scan remained barely audible during the toughest tests.

Conclusion

The Box Cube Oblivion has a lot going for it, including a great motherboard, fast storage and a swanky front panel, and its CPU performance is great too. The price also buys you a huge case, giving you ample upgrade room and plenty of space. Box hasn't made as much of the chassis as we would have liked, but there's no denying its advantages.

The GPU lets the system down at this price, though, showing the hardware could be better balanced. Few people need 32GB of RAM, for example, but a GTX 980 Ti would have opened up 4K gaming. As it is, the Cube Oblivion costs £250 more than the Scan 3XS Z170 Vengeance Ti, and offers more bells and whistles, but the latter has the upper hand in gaming performance for a cheaper price.

MIKE JENNINGS

CPC REALBENCH 2015

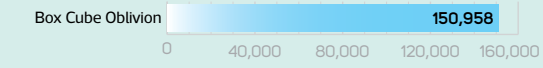
GIMP IMAGE EDITING

HANDBRAKE H.264 VIDEO ENCODING

LUXMARK OPENCL

HEAVY MULTITASKING

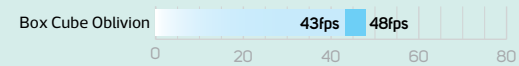
SYSTEM SCORE



INTEL REFERENCE: 131.9%

FALLOUT 4

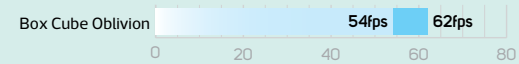
2,560 x 1,440, Ultra Detail, TAA



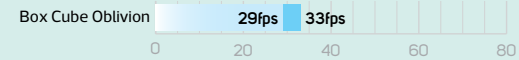
3,840 x 2,160, Ultra Detail, TAA

THE WITCHER 3: WILD HUNT

2,560 x 1,440, High Detail, AA on, HairWorks off

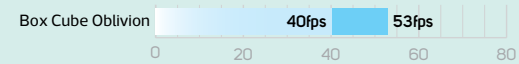


3,840 x 2,160, High Detail, AA on, HairWorks off

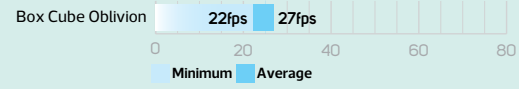


CRYSIS 3

2,560 x 1,440, Very High Detail, 0x AA



3,840 x 2,160, Very High Detail, 0x AA



SPEED	DESIGN	OVERALL SCORE
20/25	20/25	80%
HARDWARE	VALUE	
21/25	19/25	

VERDICT

A good CPU and motherboard, but the Cube needs a faster GPU in this price league.

Elite

Our choice of the best hardware available

Build a home theatre PC

The parts you'll need to build an affordable, home theatre PC that's ideal for putting in the lounge and playing back all manner of video formats. This machine will handle general computing and media tasks with no trouble, and its dual-core Skylake CPU can even handle 4K video playback. Meanwhile, its super-quiet Noctua CPU cooler prevents it from making a racket.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Lian Li PC-Q09FNB with 300W FSP SFX PSU	www.overclockers.co.uk	Issue 149, p92	£110
	Intel Core i3-6100T	www.overclockers.co.uk	Issue 149, p92	£96
	Asus H110i-Plus D3	www.scan.co.uk	Issue 149, p92	£59
	8GB Corsair 2133MHz Vengeance LP DDR3 (CML8GX3M2A2133C11B)	www.scan.co.uk	Issue 149, p92	£41
	Noctua L9i	www.scan.co.uk	Issue 149, p93	£32
	Samsung SN-208FB	www.scan.co.uk	Issue 149, p93	£13
	Seagate Barracuda 2TB ST2000DM001	www.scan.co.uk	Issue 104, p75	£54
	Samsung 850 Evo 250GB	www.scan.co.uk	Issue 141, p51	£73
	Logitech K400 Plus	www.scan.co.uk	Issue 149, p93	£32
	Microsoft Windows 10 Home Retail USB drive	www.scan.co.uk	Issue 146, p17	£85
			TOTAL	£595

Build a budget gaming PC

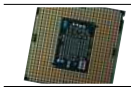
The parts you'll need to build a budget machine capable of playing the latest games at maximum settings on a 1080p monitor, and even some games at 2,560 x 1,440. The machine has a discrete graphics card, a Skylake dual-core CPU and DDR4 memory. The ASRock Extreme4 motherboard is also capable of base clock overclocking via a BIOS update.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	NZXT S340	www.overclockers.co.uk	Issue 137, p54	£60
	ASRock Z170 Extreme4	www.scan.co.uk	Issue 151, p84	£108
	Intel Core i3-6100	www.scan.co.uk	Issue 151, p18	£97
	8GB (2 x 4GB) Corsair Vengeance LPX 2400MHz (CMK8GX4M2A2400C16)	www.scan.co.uk	Issue 151, p83	£32
	Asus Radeon R9 380 Strix 2GB	www.ebuyer.com	Issue 150, p48	£154
	Samsung 850 Evo 250GB	www.scan.co.uk	Issue 141, p51	£73
	SilverStone Argon AR01	www.scan.co.uk	Issue 132, p57	£26
	EVGA SuperNova GS 550W	www.scan.co.uk	Issue 146, p50	£70
	Seagate Barracuda 2TB ST2000DM001	www.scan.co.uk	Issue 104, p75	£54
	Microsoft Windows 10 Home Retail USB drive	www.scan.co.uk	Issue 146, p17	£85
			TOTAL	£759

Build a mid-range PC

Work PC

The parts you'll need to build a solid quad-core PC with plenty of upgrade potential. This kit list gives you an all-in-one liquid cooler and a K-series Core i5 Skylake CPU, meaning you can overclock it and get some serious processing power. We've managed to get the Core i5-6600K Skylake CPU up to 4.6GHz, so it has some great performance potential. Also included is a solid EVGA PSU, afast M.2 SSD and 8GB of high-speed DDR4 memory. The core configuration assumes you won't be doing any serious gaming, however, and it relies on Intel's integrated graphics.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	NZXT H440 2015 Edition UPDATED	www.overclockers.co.uk	Issue 154, p50	£95
	Asus Maximus VIII Ranger	www.scan.co.uk	Issue 147, p44	£153
	Intel Core i5-6600K	www.scan.co.uk	Issue 145, p17	£195
	8GB Corsair Vengeance LPX 2666MHz DDR4 (CMK8GX4M2A2666C16)	www.scan.co.uk	Issue 145, p24	£37
	NZXT Kraken X41	www.overclockers.co.uk	Issue 138, p57	£70
	EVGA SuperNova GS 550W	www.scan.co.uk	Issue 146, p50	£70
	Seagate Barracuda 2TB ST2000DM001	www.scan.co.uk	Issue 104, p75	£54
	Samsung SSD 950 Pro 256GB	www.ebuyer.com	Issue 149, p48	£138
	Microsoft Windows 10 Home Retail USB drive	www.scan.co.uk	Issue 146, p17	£85
			TOTAL	£897

Gaming PC

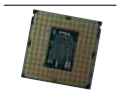
The graphics card you'll need to play current games at their maximum settings at 1080p and 2,560 x 1,440.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**1,920 x 1,080** Asus Radeon R9 380 Strix 2GB	www.ebuyer.com	Issue 150, p48	£154
	**2,560 x 1,440** Asus Strix GTX 970	www.scan.co.uk	Issue 150, p39	£280

Build a performance PC

Work PC

The parts you'll need to build a high-quality, fast PC that's ideal for multi-threaded workloads. This kit list features a high-quality, well-built case, a feature-rich motherboard and an Intel Skylake Core i7-6700K CPU. This processor's support for Hyper-Threading splits the resources of the CPU's four physical cores into a further four virtual cores, meaning it can effectively handle eight threads at once. There's also a solid Corsair 750W PSU, giving you plenty of headroom for overclocking and adding another GPU, 16GB of DDR4 memory, a high-speed M.2 SSD and an all-in-one liquid cooler.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Cooler Master Cosmos SE	www.cclonline.com	Issue 144, p41	£145
	Asus Maximus VIII Hero	www.overclockers.co.uk	Issue 146, p20	£185
	Intel Core i7-6700K	www.scan.co.uk	Issue 145, p17	£280
	16GB Corsair Vengeance LPX 2666MHz DDR4 (CMK16GX4M2A2666C16)	www.scan.co.uk	Issue 145, p24	£59
	NZXT Kraken X41	www.overclockers.co.uk	Issue 138, p57	£70
	Corsair RM750i	www.scan.co.uk	Issue 146, p55	£110
	Seagate Barracuda 2TB ST2000DM001	www.scan.co.uk	Issue 104, p75	£54
	Samsung SSD 950 Pro 512GB	www.ebuyer.com	Issue 149, p48	£251
	Microsoft Windows 10 Home Retail USB drive	www.scan.co.uk	Issue 146, p17	£85
			TOTAL	**£1,239**

Gaming PC

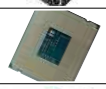
The graphics card you'll need to play current games at their maximum settings at 2,560 x 1,440 and beyond.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**2,560 x 1,440** Asus Strix GTX 970	www.scan.co.uk	Issue 150, p39	£280
	**4K** 2 x Nvidia GeForce GTX 970 4GB	www.scan.co.uk	Issue 140, p50	£560

Build a high-end 6-core PC

Multi-threaded PC

The parts you'll need to build a PC with serious power in multi-threaded software, such as 3D rendering apps, video editing programs and optimised distributed computing software. The kit list features a 6-core LGA2011-v3 CPU, which is overclockable using the motherboard and top-end cooler listed. Also supplied is 16GB of RAM, a super-fast M.2 SSD, 1TB of extra solid state storage and Asus' superb X99 Deluxe motherboard.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Phanteks Enthoo Luxe	www.eclipsecomputers.com	Issue 144, p53	£117
	Asus X99 Deluxe	www.overclockers.co.uk	Issue 136, p20	£335
	Intel Core i7-5820K	www.scan.co.uk	Issue 134, p43	£319
	Asus Radeon R9 380 Strix 2GB	www.ebuyer.com	Issue 150, p48	£154
	16GB Corsair Vengeance LPX 2666MHz DDR4 (CMK16GX4M4A2666C16)	www.scan.co.uk	Issue 136, p14	£74
	EKWB EK-Predator 240 Rev 1.1	www.scan.co.uk	Issue 148, p30	£164
	Corsair RM750i	www.scan.co.uk	Issue 146, p55	£110
	Samsung SSD 950 Pro 512GB	www.ebuyer.com	Issue 149, p48	£251
	Samsung 850 Evo 1TB	www.cclonline.com	Issue 141, p51	£250
	Lite-On IHAS124-14	www.dabs.com	Issue 99, p108	£12
	Microsoft Windows 10 Home Retail USB drive	www.scan.co.uk	Issue 146, p17	£85
			TOTAL	£1,871

4K gaming PC

This LGA2011-v3 system can support multiple graphics cards over 28 PCI-E 3 lanes, making it an ideal foundation for high-resolution PC gaming, replacing the graphics card listed above with two high-spec cards.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**4K** 2 x Nvidia GeForce GTX 970 4GB	www.scan.co.uk	Issue 140, p50	£560
			TOTAL	£2,277

Build a mini PC

Core components

The parts you'll need to build either PC. This kit list gives you a solid PSU, 16GB of RAM, an overclockable Skylake CPU, an all-in-one liquid cooler and Windows 10 Home 64-bit. Also included is a short-PCB graphics card that can play current games at their maximum settings at 2,560 x 1,440, and a high-speed M.2 SSD.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Intel Core i7-6700K	www.scan.co.uk	Issue 147, p84	£280
	16GB (2 x 8GB) Corsair Vengeance LPX 2666MHz	www.scan.co.uk	Issue 147, p84	£59
	Corsair H80i GT	www.ebuyer.com	Issue 147, p84	£86
	Asus Strix GTX 970	www.scan.co.uk	Issue 150, p39	£280
	Samsung SSD 950 Pro 512GB	www.ebuyer.com	Issue 149, p48	£251
	Seagate Barracuda 2TB ST2000DM001	www.scan.co.uk	Issue 104, p75	£54
	EVGA SuperNova GS 550W	www.scan.co.uk	Issue 146, p50	£70
	Microsoft Windows 10 Home Retail USB drive	www.scan.co.uk	Issue 146, p17	£85

Mini-ITX PC

The parts you'll need to build a pint-sized powerhouse.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Fractal Design Define Nano S	www.scan.co.uk	Issue 153, p22	£60
	Asus Z170i Pro Gaming	www.eclipsecomputers.com	Issue 147, p26	£124
			TOTAL	£1,349

Micro-ATX PC

The parts you'll need to build a mini PC that doesn't take up as much room as a full-sized desktop.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Fractal Design Arc Mini R2	www.scan.co.uk	Issue 127, p46	£70
	Asus Maximus VIII Gene	www.overclockers.co.uk	Issue 147, p42	£174
			TOTAL	£1,409

Cases

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**Budget ATX**	NZXT S340	www.overclockers.co.uk	Issue 137, p54	£60
	**Sub-£100 ATX quiet**	Fractal Design Define R5	www.scan.co.uk	Issue 137, p20	£80
	**Sub-£100 ATX performance**	NZXT H440 2015 Edition UPDATED	www.overclockers.co.uk	Issue 154, p50	£95
	**Sub-£150 full-sized ATX quiet**	Nanoxia Deep Silence 5	www.quietpc.com	Issue 144, p50	£115
	**Sub-£150 full-sized ATX**	Phanteks Enthoo Luxe	www.eclipsecomputers.com	Issue 144, p53	£117
	**Sub-£150 mid-size ATX**	Cooler Master Cosmos SE	www.cclonline.com	Issue 144, p41	£145
	**Mini-ITX tower**	Fractal Design Define Nano S	www.scan.co.uk	Issue 153, p22	£60
	**Mini-ITX cube**	Fractal Core 500	www.scan.co.uk	Issue 150, p20	£50
	**Micro-ATX**	Fractal Design Arc Mini R2	www.scan.co.uk	Issue 127, p46	£70

Graphics cards

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**1,920 x 1,080 gaming**	Asus Radeon R9 380 Strix 2GB	www.ebuyer.com	Issue 150, p48	£154
	**2,560 x 1,440 gaming**	Asus Strix GTX 970	www.scan.co.uk	Issue 150, p39	£280
	**High-end single-GPU gaming**	EVGA GeForce GTX 980 Ti Classified ACX 2.0+	www.scan.co.uk	Issue 147, p24	£594
	**4K gaming**	2 x Nvidia GeForce GTX 970 4GB	www.scan.co.uk	Issue 140, p49	£560
	**Mini-ITX**	Asus GeForce GTX 970 DirectCU Mini	www.cclonline.com	Issue 150, p38	£265

Power supplies

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**Mid-range 550W**	EVGA SuperNova GS 550W	www.scan.co.uk	Issue 146, p50	£70
	**High-end 550W**	Super Flower Leadex Platinum 550W	www.overclockers.co.uk	Issue 146, p52	£88
	**Mid-range 750W**	Corsair RM750i	www.scan.co.uk	Issue 146, p55	£110
	**High-end 1.2kW**	Corsair Professional Series AX1200i	www.scan.co.uk	Issue 111, p40	£275

Networking

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**Router**	Asus RT-AC68U	www.cclonline.com	Issue 128, p88	£149
	**Wi-Fi adaptor**	Asus PCE-AC68	www.cclonline.com	Issue 128, p88	£65

Storage

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**Hard disk**	Seagate Barracuda 2TB ST2000DM001	www.scan.co.uk	Issue 104, p75	£54
	**250GB SATA SSD**	Samsung 850 Evo 250GB	www.scan.co.uk	Issue 141, p51	£73
	**1TB SATA SSD**	Samsung 850 Evo 1TB	www.cclonline.com	Issue 141, p51	£250
	**High-performance M.2 SSD**	Samsung SSD 950 Pro 512GB	www.ebuyer.com	Issue 149, p48	£251
	**NAS box**	Synology DS216j UPDATED	www.ebuyer.com	Issue 154, p28	£131

Monitors

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**24in monitor**	Dell U2414H	www.overclockers.co.uk	Issue 129, p43	£189
	**27in 4K monitor**	Asus PB279Q	www.overclockers.co.uk	Issue 151, p40	£560
	**27in FreeSync monitor**	BenQ XL2730Z	www.scan.co.uk	Issue 143, p46	£431
	**27in 4K G-Sync monitor**	Asus ROG Swift PG27AQ	www.scan.co.uk	Issue 151, p42	£599
	**27in 5K monitor**	Dell UltraSharp UP2715K	www.scan.co.uk	Issue 151 , p44	£938
	**34in ultra-wide curved G-Sync monitor**	Asus ROG Swift PG348Q	www.scan.co.uk	Issue 153 , p28	£999

Peripherals

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**Mechanical gaming keyboard**	Cooler Master MasterKeys Pro S (Pro L version recommended if you need a numeric keypad)	www.scan.co.uk	Issue 152, p44	£106
	**Premium mechanical gaming keyboard**	Corsair Gaming K70 RGB Rapidfire UPDATED	www.scan.co.uk	Issue 154, p21	£149
	**Budget gaming mouse**	Cooler Master Xornet II	www.cclonline.com	Issue 149, p28	£21
	**Gaming mouse**	Logitech G402 Hyperion Fury	www.scan.co.uk	Issue 139, p53	£41
	**Ambidextrous gaming mouse**	Roccat Kova	www.cclonline.com	Issue 150, p28	£50
	**MMO gaming mouse**	Corsair Scimitar RGB	www.cclonline.com	Issue 150, p17	£72
	**Wireless gaming mouse**	SteelSeries Sensei Wireless	www.overclockers.co.uk	Issue 139, p61	£95

Audio

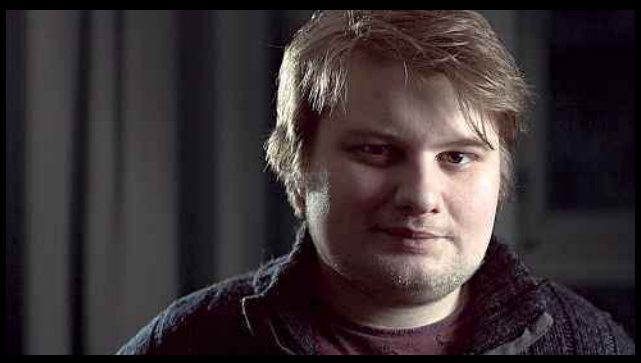
	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**PCI-E sound card**	Asus Strix Raid DLX	www.scan.co.uk	Issue 148, p28	£150
	**2.1 speakers**	Acoustic Energy Aego M	www.amazon.co.uk	Issue 142, p52	£129
	**Soundbar**	Razer Leviathan	www.overclockers.co.uk	Issue 142, p57	£160
	**Headset**	HyperX Cloud II	www.argos.co.uk	Issue 142, p46	£70
	**Surround-sound headset**	Asus Strix 7.1	www.shop.bt.com	Issue 142, p43	£126

Systems

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**Quiet gaming PC**	Scan 3XS Z170 Vengeance	www.scan.co.uk	Issue 151, p60	c.£1,500
	**Dream PC**	Scan 3XS Barracuda	www.scan.co.uk	Issue 145, p58	c.£9,499
	**Sub-£2,000 gaming PC**	CyberPower Infinity X77 Deluxe	www.cyberpower system.co.uk	Issue 150, p56	c.£1,999
	**Mini-ITX gaming PC**	Chillblast Fusion Fury Nano	www.chillblast.co.uk	Issue 147, p56	c.£1,619
	**Premium mini-ITX PC**	Overclockers 8Pack Asteroid UPDATED	www.overclockers.co.uk	Issue 154, p56	c.£3,990
	**Premium PC**	Scan 3XS X99 Carbon Extreme SLI	www.scan.co.uk	Issue 148, p62	c.£4,799
	**Water-cooled PC**	Overclockers Infin8 Toxicity	www.overclockers.co.uk	Issue 150, p58	c.£3,414
	**Gaming laptop**	CyberPower Fangbook 4 SK-X17	www.cyberpowersystem.co.uk	Issue 152, p30	c.£1,909
	**Thin and light gaming laptop**	Scan 3XS LG15 Vengeance G-Sync	www.scan.co.uk	Issue 153, p51	c.£1,480

Games

Featured this month



RICK LANE / INVERSE LOOK

VR NOT ALONE

Virtual reality is an incredible invention, but chasing 'full-immersion' gaming is a mistake, says Rick Lane

At last month's EXG Rezzed expo, London's Tobacco Dock was conquered by VR. The HTC Vive and PlayStation VR dominated huge areas of the show floor, while many indie developers demonstrated games with an Oculus Rift headset. Little over two years ago, VR was still a futuristic dream, like hovercars or teleporters, and yet virtual reality was so abundant here that it was almost taken for granted.

Games and technology expos are an ideal place to showcase VR – there's plenty of space to move around and, provided you don't mind 100 people gawping at you as you flail around with a box strapped to your face, you can experience VR without sacrificing your wallet to the gods of HTC or Oculus. Moreover, the idea of being truly 'immersed' in a virtual world is very attractive. However, I wonder whether VR's popularity at these events reflects the reality of making VR commercially viable, and whether this notion of true 'immersion' is chasing a pot of gold at the end of a virtual rainbow.

Gaming has always had a curious fascination with realism. Since the advent of 3D graphics, chasing photorealism has been one of the defining goals of mainstream studio development. However, such a focus has always restricted the output of mainstream studios, and it's often games that abandon this notion, focusing instead on creating a new aesthetic style or innovative systems, that prove to be the most interesting or influential.

With VR, the immersive factor is already limiting what developers can achieve with the hardware. Take the HTC Vive. Alongside the hardware itself, the Vive's room-scale VR feature requires an empty space measuring at least 1.5 x 2m. Ideally, it needs an empty room.

> You can't make the walls of your house disappear when you bump into them

But no matter how large a space you can dedicate to a Vive, you can't make the walls of your house disappear when you bump into them. To avoid breaking the immersion, you're limited to creating room-sized games. So far, the game industry has responded with ingenuity. VR is fantastic for cockpit-based games such as Elite Dangerous or Euro Truck Simulator. Alternatively, there are standing games such as Job Simulator and Giant Cop. Another fun possibility is VR strategy games, in which you can pick up and direct units using your hands.

They're all fine ideas, but many current VR games are little more than experiments that will entertain us for a few minutes to an hour. How much more mileage can you get from games that restrict the player to the space of just a few feet? I'm also painfully aware of how motion controls, which had similar limitations, largely failed to capture the imaginations of both players and developers once we were past the initial novelty stage.

The difference with VR is that it doesn't *need* to abide by those limitations. Sure, a Vive may not be quite as immersive if you're playing an FPS while sitting on a chair, but it's still pretty darned immersive. It's also much more convenient, and that's an important factor if VR is to become more than a specialist curiosity.

VR offers an incredible experience, and the technology has the potential to revolutionise how we play games. At the moment, though, it's still merely potential, and the only way it can be anything more is if it grasps the public's imagination. Doing so requires not just technological prowess, but ingenuity on the part of the developers, and a setup that's comfortable and convenient enough for players to want to use on a regular, protracted basis. CPC

Rick Lane is Custom PC's games editor. @Rick_Lane

Dark Souls III / £39.99 inc VAT

DEVELOPER From Software / **PUBLISHER** Namco Bandai / **WEBSITE** www.darksouls3.com

OVERALL SCORE
93%

/ VERDICT
Visually stunning with fantastic combat and smarter, more refined systems, Dark Souls III is an RPG to savour.

Dark Souls has slowly gathered a reputation as one of the best games ever made. Its emphasis on learning, discovery and interpretation broke the mould in an industry terrified of ambiguity and challenge. Dark Souls arrests the player's attention with its uncompromising difficulty, forcing players to rewire their gaming brains. Through this altered perspective, the game reveals a new approach to storytelling, environmental puzzling, combat and multiplayer gaming that's integrated into a seamless whole.

If Dark Souls was the gaming equivalent of Keats' Grecian Urn, however, then Dark Souls II was an urn that had been dropped and hastily glued back together. While resembling the elegance and form of the original, and exhibiting some refinements on the initial design, it was also cracked and uneven, the surface too rough and the joints too visible. The cohesive world of Lordran wasn't reflected in the waters of Drangleic, and the shards of narrative were fragmented even by the original game's delectably cryptic standards.

From Software's creative director, Hidetaka Miyazaki, played a diminished role on Dark Souls II, as he was busy working on the PS4 exclusive Bloodborne. For Dark Souls III, however, Miyazaki has again assumed control over creative duties, and the result is striking. Dark Souls III harks back to the glories of the original, while also unapologetically progressing forwards.

Dark Souls III clearly understands its position as a sequel to what some consider the best game of all time, and infuses this idea into the game's foundations. The Kingdom of Lothric is built atop the smouldering remnants of Lordran, and the game involves revisiting several key locations from Dark Souls, barely recognisable from their former glories. The best example is Firelink Shrine, the main 'safe area' of both games. In Dark Souls, Firelink was a small slice of pastoral greenery surrounded by ancient ruins. In Dark Souls III, it's an opulent throne room on a huge pile of ash.

This change speaks volumes about Dark Souls III – it starts in a grander, more elevated position from the original game, but only because it stands on top of the legacy of that first, transcendent game.

It's from the ash piles of Firelink where your character must strike out on a new adventure as the Ashen One, an undead warrior tasked with returning four Lords of Cinder – great and terrible creatures who hold power over life itself – to the vacant thrones in Firelink Shrine, in order to keep the guttering flame of life burning in Lothric.

While there are plenty of nods to the player's adventures in the first game, including old locations and, curiously, returning characters (despite centuries passing between the two stories), Dark Souls III tells a very different tale, not just in terms of subject, but also in tone. Dark Souls III is far less enigmatic than the original – the level design, narrative and systems are all conveyed with far greater clarity.






Upgrading weapons, for example, is much easier. Resources are abundant and weapons can be infused with special powers within just a few hours of leaving Firelink. The world is less of a convoluted maze too, constructed instead out of vast open areas, which are challenging to navigate without being completely bamboozling. The story is also much clearer when achieving your initial objectives, and characters tend to speak more frankly.

Miyazaki has made the basics more straightforward. Dark Souls III assumes we're familiar with the tricks of the first game, so it doesn't attempt to emulate them. Instead, it refines them so it can focus on the more important areas.

Combat, for example, has been transformed. The move to the Bloodborne engine allows for slicker, more aggressive swordplay, and the game designers use this opportunity to create some truly fierce and tricky opponents. Enemy attack cycles are longer and less predictable. The iconic silver and black knights of Anor Londo, for example, blend long, sweeping attacks with quick stabs and horrendously powerful lightning-infused strikes. Where Dark Souls allowed players to muddle through combat with one particular tactic, Dark Souls III necessitates a comprehensive understanding of the combat system. You must know when to roll, but also when to block and parry, when to attack from distance and when to move in close.

This system may sound formidable but, because the weapon upgrade system has been simplified, it encourages much greater experimentation. In addition, bonfires are more abundant and the journeys to face new bosses are less arduous, so after a drubbing, it's much easier to return to Firelink, lick your wounds and rethink your strategy. That's good, because Dark Souls III's second half becomes ferociously difficult. Initial bosses such as Vordt and the Curse Rotted Greatwood won't trouble veteran players, but later adversaries such as Pontiff Sulyvahn and the Dancer of the Boreal Valley offer incredible duels, which require atomic precision and scythe-sharp skills to win.

What's most satisfying about Dark Souls III, however, is its return to the beautiful worldly integrity of the first game. The Kingdom of Lothric is built around the imposing edifice of Lothric Castle, a huge fortress that sits on top of an ancient volcanic mountain. Wherever you go in Lothric, the castle can be seen, acting as a proud and foreboding landmark that shows both how far you've come in the game, and how far you've yet to go.

The Bloodborne engine also enables some truly dazzling environment design too. Emerging from the Catacombs of Carthus and seeing what lies ahead is one of the most tremendous moments we've experienced in a video game. And the beauty of Dark Souls is that, if you can see something on the horizon, at some point you'll be able to explore it, do battle with the foes that await within it, and plunder its scattered treasures, from which you can glean arcane snippets of the game's fragmented story.

Aside from the narrative acting as a blunt instrument at times, the game's problems are mainly technical. In some of the more visually impressive areas, it struggles to keep up the frame rate, even on a decent GPU, while there's an ongoing lighting bug that causes the game to crash if you're near a bonfire and using a more effects-laden weapon. These issues are infrequent and hopefully fixable, but Dark Souls suffers from a choppy frame rate more than most games.

Otherwise, though, Dark Souls III is a fitting conclusion to the trilogy, and a satisfying sequel to a groundbreaking RPG. If Dark Souls II left you feeling a little hollow, then Dark Souls III will rekindle those embers of hope.

RICK LANE

Day of the Tentacle Remastered / £11 inc VAT

DEVELOPER LucasArts / Double Fine / **PUBLISHER** Double Fine / **WEBSITE** http://dott.doublefine.com

Custom PC Approved

Monkey Island may be LucasArts' most critically acclaimed adventure game, but Day of the Tentacle is probably the studio's finest point-and-click work. The sequel to the groundbreaking Maniac Mansion, Day of the Tentacle continues its madcap story of crackpot scientists and sentient arthropod limbs with an even zanier premise and brilliantly bamboozling puzzles.

Double Fine's update of the 1993 classic provides a visual overhaul of the original pixel art, a remastered soundtrack and orchestral score, and a modernised UI that makes interactions faster and simpler without compromising the hallmark humorous red herrings.

It's a decent update, although not a spectacular one. The art looks a little rushed in places, while the sharper images starkly contrast with the spartan animations that remain unchanged. That said, the remaster does enough to warrant a purchase in order to experience this ingeniously conceived adventure game.

Day of the Tentacle sees a group of teenagers helping scientist Dr Fred to prevent Purple Tentacle from taking over the world. However, Dr Fred's attempt to send the kids back in time to the day before, and thereby switch off the sludge machine that transformed Purple Tentacle into a cackling megalomaniac, goes awry. Lackadaisical roadie Hoagie

OVERALL SCORE
87%

/ VERDICT
A passable remaster of a truly splendid game, Day of the Tentacle makes a welcome and long overdue return for modern audiences.

ADR1FT / £14.99 inc VAT

DEVELOPER Three One Zero / **PUBLISHER** 505 Games / **WEBSITE** www.ADR1FT.com

A first-person adventure game set in and around a space station in the wake of a cataclysmic disaster, ADR1FT puts you in the spacesuit of Alex Oshima and tasks you with surviving in the most hostile environment known to man. It's a horror game where the monster is your surroundings.

The initial encounter impresses. You awake to find yourself drifting in space surrounded by the wreckage of the Han IV space station, with Earth's royal-blue curvature visible in the background. It's a sight that in equal parts is both stunning and foreboding. Even more exciting is the realisation that ADR1FT is truly 3D. The remnants of Han IV aren't just scattered around you, but also above and below you. Some parts are static while others spin gracefully in the frictionless void. Readjusting your perspective to accommodate the workings of space is quite tricky, and solving ADR1FT's 3D puzzle is the most satisfying part of the experience.

Sadly, while ADR1FT succeeds as a spacewalk simulator, it fails as a survival game. The central system, in which your air supply is also your sole source of propulsion, doesn't provide enough tension. The necessary O2 canisters are so abundant that you only risk running out of oxygen if you go completely off course. Similarly, the fact that your suit can be damaged by even a slight collision should generate suspense, but suit degradation is poorly communicated, and impacts lack any great feeling of force.

ADR1FT's biggest problem, though, is that there's very little to do. The only points of interaction are doors, computer terminals and a few audio-logs, all of which use the same context-sensitive interaction system. While ADR1FT effectively communicates the feeling of being in space, it doesn't communicate the feeling of being an astronaut. You end up watching Oshima perform complex tasks in lengthy, locked animations, wishing you could take control, flip a few dials, push a few switches and actually get hands on with the game's wonderful environments.

The story doesn't help either. After the initial catastrophe, which you don't even see, no further tension is derived from

OVERALL SCORE
50%

/ VERDICT
A remarkable achievement in environment design, but ADR1FT is held back by lacklustre systems and a dearth of interactivity.

200 travels years into the past, and quirky medical student Laverne 200 travels years into the future. With the aid of Bernard, who remains in the present, the trio must get back to their original timeline.

Unlike most adventure games, where puzzles appear as sequential interruptions to the plot, Day of the Tentacle has a core concept around which to frame its puzzles – time travel. The past, present and future are all linked via time-travelling portaloos known as Chron-o-johns, enabling objects to be transferred between the three characters and their different timelines.

In case you haven't played the game before, we won't give away the solutions to any of the puzzles – suffice to say that time travel acts as a logical lynchpin for some brain-meltingly irreverent conundrums, and it also allows for diverse locations within a limited environment. You only have to learn the layout of the building once, yet its contents are fundamentally different each time.

Day of the Tentacle's humour stems more from its wacky puzzle solutions than the script itself, although there's a smattering of genuinely excellent jokes, and Laverne's borderline psychotic grins and giggles had us in stitches at various points. The remaster itself might not be technically spectacular, but as an all-round experience, from concept and environment design to characterisation and scriptwriting, Day of the Tentacle is a strong candidate for adventure gaming's finest hour.

RICK LANE

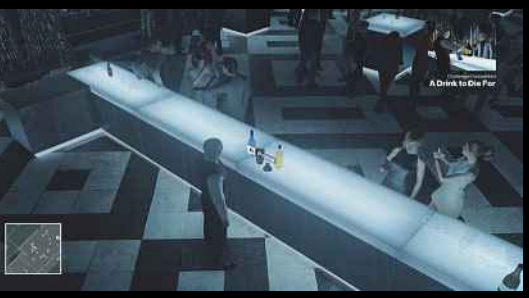
the situation. Instead, you're tasked with completing four very similar objectives. There are no twists, no escalation and no deterioration. The entire game becomes one long, numbing routine.

There's some decent character development, particularly with regard to your role on the station and the reason behind the disaster, but some of the side character traits don't make sense. The station's doctor is a recovering drug addict, while another crew member is apparently dying of cancer – neither would pass a screening test for a high-risk space endeavour.

ADR1FT's intentions are admirable and the visual effects are spellbinding, but after the initial dazzle, this game quickly turns empty and cold, like a supernova collapsing into a black hole.

RICK LANE







Hitman / £10.99 inc VAT

DEVELOPER IO Interactive / **PUBLISHER** Square Enix / **WEBSITE** www.hitman.com

OVERALL SCORE
82%

/ VERDICT
Short but immensely replayable, Hitman marks a promising return to form after the disappointing Absolution.

After three Hitman games best described as 'good, but not great', the series hit a high with Blood Money, one of the best sandbox games ever. Hitman: Absolution came a few years later, but it was decidedly mediocre third-person action game that forgot nearly all the lessons learned from Blood Money. This latest game, simply titled Hitman, promises a return to the open design and creative play that made Blood Money such a landmark title, albeit via a peculiar episodic release format.

Indeed, the first episode only contains one true Hitman mission, although it's probably the best individual Hitman mission ever created. Hitman takes us back to the formative years of chrome-domed professional murderer Agent 47.

It guides us through 47's training at the hands of the mysterious Agency, providing a comprehensive tutorial, before sending you to Paris on the Showstopper mission, 47's first ever contract.

If you want more, the tutorial missions are essentially standard Hitman missions too. The only difference is that the environments are constructed out of wood and cardboard prefabs, and the weapons are 'dummies', which for all intents and purposes are identical to 47's standard arsenal. The first mission guides you through the basic controls, while the second is a rerun of the first that encourages you to experiment. 47's final test involves a recreation of his boss' finest hour, taking out a Chess prodigy-turned-arms dealer in a heavily guarded airbase.

However, Episode 1 is really all about Showstopper, in which 47 visits a Paris fashion show to dispatch two famous designers with a lucrative side business in illegal information brokering. The setting is an enormous Parisian mansion with expansive gardens, hundreds of guests and dozens of guards.

Showstopper's visuals look tremendous, and it's also a truly open sandbox. There are countless ways of approaching your target, from a straightforward bullet to the head in a quiet corner, to adding emetic rat poison to a cocktail before hiding in the bathroom for your target and finishing them off. The game's stealth systems are slick and cleverly communicated, while the AI is balanced perfectly to be challenging without inhibiting creativity.

The game compensates for the relatively small number of missions with its low price, and the game's Contracts system also offers some replayability, enabling players to create their own missions using the Showstopper mission, and attempt challenges created by other players and the developers. Importantly, the Showstopper mission is large enough to make this system worth investigating, as there are so many ways to explore it, and so many potential assassination opportunities.

Episode 1 of Hitman has proved itself as a fine launch pad. Showstopper is some of IO's finest work, and if it can keep that quality consistent in future episodes, we could have another Blood Money on our hands.

RICK LANE

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Moving to Torque3D's deferred rendering engine enabled Mode7 to massively upgrade the visuals for Frozen Cortex

RICK LANE / THE ENGINE ROOM

Mode 7

Rick Lane speaks to Ian Hardingham about the tech behind Mode 7's Frozen Synapse and Frozen Cortex games

Game engines aren't fixed products. Like games, they're fluid creations that evolve and shift, sometimes into completely different programs. These changes aren't restricted to first-party engine development either. Developers will frequently alter third-party tech according to their needs too.

Such is the case with Mode 7, an Oxford-based developer of games including Frozen Synapse, Frozen Cortex and the upcoming Frozen Synapse 2. All of Mode 7's games are built on the Torque engine, an open-source game development toolkit created by GarageGames, which was originally the engine for Tribes 2. Ian Hardingham, co-founder and lead programmer of Mode 7, has used Torque as the basis of his games since his days at university. It was the foundation of Mode 7's first game, the multiplayer sword-fighting sim Determinance. But when it came to developing the second game, the simultaneous turn-based tactical shooter Frozen Synapse, Hardingham realised Torque wouldn't suit the project in its current state.

'I knew Torque had the features I wanted for making Frozen Synapse, but I also didn't want to be bogged down with Torque's game-logic code, which had been originally designed for an open-world FPS game with skiing,' Hardingham says.

'I wanted Torque's netcode and its GUI code, which is surprisingly competitive to this day, 15 years after Tribes 2 came out. I also wanted its event handling, scripting language and so on, but not the structure for the core game modes.'

Frozen Synapse's key mechanic is that both players take their turns at the same time. Players input commands to their squads of special forces soldiers, ordering them to move, take cover and aim at enemies without knowing what the other team will do. When both players are satisfied with their commands, the game calculates the overall outcome of both sides' decisions and resolves the scenario. It's about attempting to predict and outwit your opponent.

'The very first thing I did was create the Frozen Synapse "simulation layer" from scratch, with very few links into Torque. The core "tech" in FS is the ability to test and rewind the simulation; getting that perfect on its own was the first challenge,' Hardingham explains. 'The other significant piece of work was the server, which offers many features that were unheard of when FS first launched. It was built from the ground up, and while it technically used Torque for scripting and TCP handling, it's since been rewritten in Ruby.'

Frozen Synapse's engine is deterministic; in layman's terms, this means that whenever the game logic resolves a particular outcome of a turn, it will return the exact same solution every time. 'One of the big design decisions was to have no luck,' Hardingham says. 'I wanted to have no luck because you don't know what your opponent is going to do.'

When Frozen Synapse launched, its engrossing, predictive puzzle proved enormously popular, so Mode 7 decided to explore the mechanic a second time in a different context. Frozen Cortex uses the same systemic premise as Synapse – players both make their tactical decisions simultaneously and the game resolves the solution from those inputs – but it translates the concept to a futuristic American football-style sport.

For Frozen Cortex, Mode 7 switched to the new version of the Torque Engine – Torque3D. 'T3D had a rather modern deferred rendering engine that allowed our art team to create what I think is one of the best-looking games of 2015.' The visual upgrade between Synapse and Cortex is remarkable, switching the basic, top-down graphics of Synapse for a fully 3D rendered stadium with hulking, gleaming robots that burst with sparks whenever they tackle an opponent.

An even more important difference between Synapse and Cortex, however, was Mode 7's work on the AI. In Cortex, the AI characters have to work much more closely as a team, passing the ball to one another, defending in tackles, making runs and so on.

'It was the work of many months to get it playing well and calculating fast enough that the player wasn't twiddling their thumbs for too long between turns,' Hardingham says.

Mode 7 is now returning to Frozen Synapse with a sequel, expanding the simple tactical shooter into a much larger strategy game in the vein of XCOM: Apocalypse and Crusader Kings 2. Frozen Synapse 2 takes place in a procedurally generated city, in which multiple factions vie for technologies left behind by the incursions of a mysterious entity. The player must compete against these factions, playing them off one another in order to get to these technologies first. Basically, it takes Frozen Synapse's combat and adds a giant metagame of politicking on top of it.

Cortex is much more team-orientated than Synapse, which necessitated a significant AI update

FS2's new level generation system allows for much more complex designs

The key additions are the city generator, which Mode 7 has adapted from a third-party tool that generates top-down city maps, and the AI, which was written in-house. 'The FS2 faction AI uses an interesting logic system where it combines high-level goals – such as "I want to antagonise the Blue Sunlight faction" with a logic programming-style search of how to achieve the goal,' Hardingham explains. 'I write a series of simple rules, which have actions and outputs, and the AI can work through the many different possible ways it could antagonise an enemy to find the one that's easiest and most likely to succeed.'

The idea is to create factions that have individual goals and pursue them autonomously, reacting to the moves of other factions and the player to create unique and dynamic scenarios. 'You have these minor factions, such as the Baker Faction, and they generally just sit there being Bakers, but if you screw them in the right way, you can raise their power level, and the Bakers have it in for the parcel delivery company. If they ever become powerful enough to recruit their own mercenaries, they'll go and ruthlessly attack the parcel delivery company,' Hardingham says.

What began life as an engine designed for a fast-paced FPS is now being used for a game that's one step away from a grand strategy.

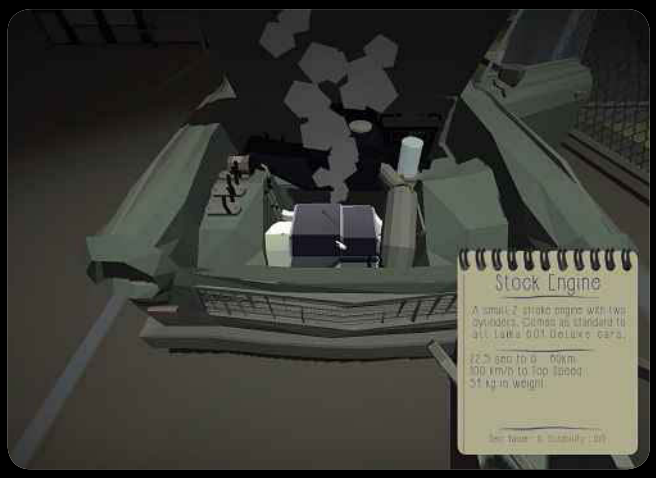
AI that once only thought about dodging and shooting has been swapped for virtual brains that plan and scheme on a much broader political spectrum. The evolution of Mode 7's games, and the Torque engine alongside side it, really demonstrates the potentially malleable and unpredictable nature of game development. CPC





INDIECORNER

In Rick Lane's indie corner this month: bad cars, big cops and sneaky ships. Incidentally, this is also the plot for the new Die Hard



Jalopy

DEVELOPER Minskworks / **RELEASE** Out Now (Early Access)

Perhaps the first road trip simulator, Jalopy involves navigating a dilapidated Laika 601 Deluxe through the crumbling remnants of the Soviet Union. Starting at a garage in East Germany, you navigate procedurally generated roads and countryside inspired by the Eastern-bloc countries of the early 1990s, maintaining and upgrading your car as you progress.

It's an ingenious concept that blends the freedom and wanderlust of walking simulators with detailed car simulation. Various aspects of your car must be monitored and maintained, including its fuel use, tyre condition and engine parts. Carburettors, batteries and fuel tanks can all be damaged, repaired and upgraded. Miss the opportunity to refuel and you could end up stranded at the roadside, faced with a long rainy walk back to the station.

Jalopy's abstracted visuals brilliantly convey the mood of socialist Eastern Europe on the cusp of an economic revolution, while the game's surprisingly tactile nature, from fiddling with your engine to picking up individual items to buy in a shop, help to orientate you in this unique, foreboding and optimistic game world. Development is still in its very early days – the driving model in particular is too lightweight – but Jalopy already looks set to be a fascinating game.

Heat Signature

DEVELOPER Suspicious Developments / **RELEASE** TBA

Heat Signature comes from Tom Francis, creator of Gunpoint and the tutorials we follow in our 'Custom PC makes a video game' series. This procedurally generated 2D space sim allows you to fly around the galaxy in a big spaceship, and also sneak aboard other people's spaceships and fly them. It's basically an interstellar stealth game. You start off piloting a flimsy vessel in a galaxy filled with vastly more powerful enemies. You need to fly close and attempt to dock with these enemy ships, using inertia rather than thrusters to keep your heat signature low, before carefully dispatching the crew from the inside.

Francis is inspired by games such as Spelunky and the idea of universal systems, where in-game logic is consistent for every action. When you dock with an enemy ship, it won't stop flying. As long as you remain undetected, it will continue going about its business, even engaging in combat with ships it deems to be enemies. Heat Signature's ships are also highly destructible, so you can blow a hole in the side of one and watch the crew get sucked out by the ensuing vacuum. This could equally happen to you, however. Indeed, enemies who catch you sneaking around their vessel will attempt to lock you out and jettison you into space!

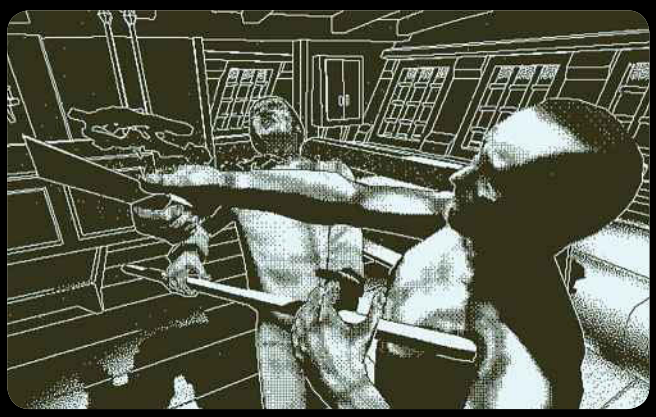
Shadwen

DEVELOPER Frozenbyte / **RELEASE** Spring 2016

Shadwen casts you as an assassin in a medieval-ish city on a mission to kill a king. You can choose to carve your way through the city's guards to get to your target, or stick to the shadows and use more evasive measures. So far, so Dishonored, yet there's an unexpected twist. Early in her adventures, the plucky murderess encounters an orphan named Lily, and decides to take the girl under her wing while continuing her mission. Your approach to dealing with guards and hazards will affect Lily's behaviour, although it's currently uncertain precisely how this will work.

There are other neat ideas too. Like the stylish FPS Superhot, time only moves when Shadwen moves, giving you plenty of room to plan how to deal with some guards. The price for this generous mechanic is that there's no room for error – it's game over if you're spotted by any guards.

Shadwen is being developed by Frozenbyte, creator of the delightful Trine series, so we can expect gorgeous environments and physics-based puzzling, albeit with a more open world and creative toolset this time. It will be Frozenbyte's first truly 3D game, after Trine 3 dabbled with a 2D and 3D combo with mixed results. Hopefully, Frozenbyte's tech has matured enough for Shadwen to flourish.



Return of the Obra Dinn

DEVELOPER Lucas Pope / **RELEASE** TBA

In 2012, Lucas Pope released Papers Please, a truly brilliant game about manning a border control post in a Soviet-esque dictatorship. With ingenious mechanics, and tasking you with achieving fearsomely tricky balance between seeing to the needs of your family and not cutting corners in your job, it's one of few games that conveys a powerful meaning entirely through its systems.

Pope's follow-up, Obra Dinn, is a first-person mystery set in 1807. It sees you exploring a ship that went missing years beforehand, but has recently turned up, completely abandoned. It's in the vein of titles such as Everybody's Gone to the Rapture and The Vanishing of Ethan Carter, but intriguing because of Pope's excellent grasp of systemic design. Such games are notorious for being visually stunning but interactively lacking, and we're hoping Pope can find a way to make Obra Dinn more tactical and engaging.

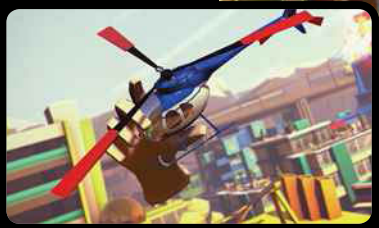
There isn't a huge amount of information about the mechanics, apart from the fact that the player is equipped with a pocket watch that enables them to manipulate time.

The aesthetics are intriguing too, employing a black and white dithered effect, which Pope says is meant to reflect the look of old Mac games in a real-time, 3D environment.

Giant Cop

DEVELOPER Other Ocean Interactive / **RELEASE** Autumn 2016

One of the most exciting VR projects in development, Giant Cop sees you literally playing a giant policeman. Standing tall over the open expanse of Micro City, you must solve crimes using your massive hands, plucking tiny criminals off the streets and flinging them into a huge, goal-shaped prison.



What makes giant cop interesting isn't so much its bizarre premise, although that's certainly fun, but how it plans to expand its VR experience beyond the scope of a simple demo. Micro City is an open sandbox, around which you're free to roam, and there are various types of crimes to solve, from bank heists to murders. You can upgrade the city's security in order to better detect crimes and prevent them from happening, although some of these upgrades come at a cost to the city's liberty. The population will also react to your policing method, so your reign as Giant Cop could go a bit King Kong if you abuse your power.

It's a neat concept that cleverly circumvents the problem of the limited space in which current VR tech can function. Just how much fun Other Ocean can glean out of Micro City, however, remains to be seen. CPC

BEFORE

AFTER

Pimp My Rig

Want to make your PC stand out from the crowd? Antony Leather readies the spoilers and powers up the Dremel

While the world of PC modding partly stems from early PC enthusiasts tinkering with their cases to improve their layout, features or cooling, making them look good was also a big driver in what's now a massive, international modding scene. Many of the original techniques, such as adding LED fans and lighting are still popular today, but there's now a much wider range of techniques used, and off-the-shelf parts are now so popular and varied that they make up their own industry.

Best of all is that, while some methods require tools and workshops, many modding jobs can be performed at home in a garage or garden. Some simple mods don't even require paint or tools, so anyone can add custom details to their case and for not much cash either. This month we'll be covering several simple customisation techniques, from detail painting to lighting and engraving – simple tasks that can still make your PC look fantastic. Some start from as little as £5, so whatever your budget, there will be a mod for you.

TOOLS YOU'LL NEED

Acrylic sheet / www.plasticsheets.com

Primer, matt and gloss spray paint / Most hardware stores

Dremel and attachments or jigsaw / Most hardware stores

RGB LED strips or kit / www.scan.co.uk

Frog tape / Most hardware stores

Painting

By far the most effective way to revolutionise your PC's appearance is to grab a few spray cans. However, there are several distinct ways you can spray your PC and numerous bits of hardware you can paint too. We'll be looking at six of these that don't require masses of space as well as covering the paints you should use, and also looking at custom services that mean you can get your case or components sprayed by a third party.

PAINTING FANS

Most fans are black, which means you don't necessarily have to paint them if you're colour-matching all the different details of your case, but painting the blades can look especially good when they're rotating. Ideally, you want to remove the blades from the chassis, if possible. You can check if you can remove the blades by turning the fan over and pushing on the rear of the hub (don't push on the blades). With a small amount of force, the fan section may detach, but otherwise, you'll need to mask up the fan in order to spray the parts you want to paint. 1

If you can't remove the fan section, you'll need to mask off the frame using Frogtape – it's better to get some contrast and to just paint the blades to makes them stand out. Start by inlaying some masking tape around the inside of the frame, before switching to the rear and covering the frame from the other side. The only parts that should be exposed are the hub and fan blades. 2

You'll now need to remove any stickers on the hub. If necessary, use a scalpel to lift any stickers. If there's any sticky residue left, you can use isopropyl alcohol or Mr Sheen to remove it by applying a small amount, then allowing it to soak into the glue before wiping it off. You can then clean the fan using sugar soap, or another solution for preparing paint surfaces, to clean off any dust and fingerprints that could impact on the paint finish. 3

Now it's time to get painting. As we'll only be dealing with small parts in this guide, a large cardboard box, such as a PC case box, is ideal for creating a mini spray booth. This box will protect any surrounding objects from paint overspray, and also reduce the chances of surrounding debris being blown around and landing in your paint. 4

If you're spraying the fan section on its own, you can use a small cylindrical object inserted into the rear of the hub to prop up the section in the air. This prop enables you to spray both sides at once, saving time.

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Spraying the fan section when it's mounted in the frame can be a little easier as the blades are already suspended – just tape the frames to your box to keep them in place. You're then ready to spray your primer onto the fan blades.

For the best finish, especially on black fan blades, use a standard grey or white spray primer first. If your blades are glossy plastic, consider using plastic primer, such as Plastikote plastic primer as well. Use a white primer if you're planning to paint your fan blades with bright colours, which will help to make them more vivid. Alternatively, you can use standard matt white spray paint, but you'll need to leave it to dry for at least 30 minutes between coats.

Most blades are fairly coarse as standard, so there's little need to sand them. You would sand down primer on larger surfaces, such as side panels, to ensure an even surface that's ready for paint, but the benefits of sanding primer between coats are minimal for small, uneven surfaces such as fan blades.

Apply the primer in light coats, using a steady sideways action from 40cm away. You'll likely need no more than three or four coats to cover the underlying plastic colour. Allow each coat to dry for 15 minutes and try to coat the blades evenly. One issue when you're spraying fans, of course, is that they're moving objects – the blades can become unbalanced after painting, which may affect their noise levels or even cause vibrations. However, that will only happen if you apply far too much paint or if the paint runs. 5

As we were writing this feature, it was snowing in the UK (in April!), which clearly isn't ideal if you're using a spray booth outside, so use your garage if you have one. Don't be tempted to spray in a confined space though. You need ventilation, and you should wear a mask as well.

One trick to improve the finish in colder conditions is to warm the paint first by leaving the can in a sink filled with warm water. Don't use boiling water – use a temperature in which you'd feel comfortable bathing. This procedure can help the paint to dry in cold conditions, especially in the early stages. Using a heater or lamp in a garage can also help, but don't spray while the heater is on, and make sure you allow the fumes to die down before you turn on any heat sources.

Your next job is to apply your chosen top-coat colour; in our case, we've opted for gloss orange and will be using a Plastikote spray can. As with the primer, use thin coats of paint, moving in a sideways motion from a distance of 40cm. Three coats should be enough, allowing each to dry for at least 30 minutes before applying the next. 6

The final layer is the clear coat or lacquer, which gives the paint a sheen and protects the paintwork. We've used Montana spray varnish, as we've found it gives the best finish. If you use gloss paints on items that won't be touched or used very often, you can often get away without using clear coat, but we're going to apply it to our fan so that its gloss finish matches the other parts we plan to paint.

You apply clear coat in a slightly different way from top coat and primer. Start by applying a single thin layer, then apply a second generous layer, watching for the spray to meld into a coating that flows seamlessly over the item you're painting.

You only need to do this job once, although you can apply more coats if you require more gloss. Allow the clear coat to dry for 24 hours, or you risk damaging it. You can then remove the masking. 7

PAINTING CASE DETAILS

There are a number of details on a case that you can paint without needing to spray the entire chassis. The PSU cover is one of the easiest ones, if you have one, and our case has a removable fascia that's ideal for adding a little splash of colour without going overboard. You can also consider painting mesh sections, drive bays or other removable parts.

Start by removing the part you want to paint 1 – most case parts are screwed into place, but you may have to drill out a few rivets and replace them later with a rivet gun. It's usually best to remove the part to paint it, but sometimes you might get away with masking it off inside the case. You'll also need to cover the rest of the case to prevent overspray. Our PSU cover also featured an illuminated logo that we wanted to keep, so any logos or text will need to be removed or masked off before you start painting. 2

As with the fan blades, glossy plastics may benefit from being coated with plastic primer before you apply your undercoat, but in our case, a standard coat of white matt spray paint was all that was needed for a perfect undercoat. Lay larger items flat when you spray to prevent the paint running. With undercoat and primer, you only need three or four light coats, or enough so that the black plastic doesn't show through the primer. Move the spray can in steady, sideways motions from a distance of around 40cm. 3

Allow the undercoat to dry for an hour, then apply your gloss colour coat using the spray can. As this section is at the edge of the case, you'll want to create a fairly thick layer of paint in case of dings and scratches. Build up the layers gradually, though, and don't apply too much at a time. 4 Typically, four or five coats will be fine to create a thick enough layer of colour coat.

Allow the colour coat to dry for a few hours then apply the clear coat. Use the same method we used with the fans earlier – apply a thin layer, then a generous layer over the whole part, so that the coating runs together to form a sleek glossy layer. 5 Again, be fairly liberal on these types of exposed parts,

PAINTING YOUR MOTHERBOARD

Painting your motherboard's heatsinks and shrouds is a great way to colour-match your components. It's easy as well, although remember that you'll likely void your warranty and affect your motherboard's resale value. Start by locating the screws on the rear of the motherboard that correspond to the heatsinks or shrouds on the top side.

Once you've removed your heatsinks, check them for thermal pads, 1 which you'll need to remove and place carefully back on to the motherboard to protect them, in the exact place as before. You don't want any dust or paint getting stuck in them, or you could compromise cooling and have to go through the hassle of replacing them.

The sections you spray are up to you. We've opted to add orange details to the edges of our heatsinks, so we won't lose the logos or have to mask off the lighting area in our Asus Maximus VIII Hero Alpha's chipset heatsink. For any areas that require neat lines, use Frogtape for masking, rather than masking tape, as the latter can allow paint to creep. 2

As with the other components we've painted, apply primer and a white undercoat if necessary before moving to the colour coat. You may need to spray lightly in several layers from different angles to get the paint to penetrate the heatsinks. 3

There may be text and logos on your that you want to stand out in your chosen colour. Dealing with recessed text is easy and cheap – you can use a small paintbrush, or even a cocktail stick. Apply grey or white primer, then spray some colour gloss spray paint into a small container – you can then drop small amounts of paint into the recesses. The spray paint is runny enough to make this job quick, simple and effective, and any spills can be wiped off the rest of the shroud using isopropyl alcohol and a kitchen towel once it's dry. You can apply an undercoat and then a colour to these parts, or just paint them white to help them stand out a little better. We've also painted the small triangle recesses orange. 4

applying a thick coat to protect the base layers. If you want super-glossy finish, you can also consider using automotive polish to buff the paint to a shine.

The clear coat will take at least 24 hours to dry properly, and longer if you leave it in a cool garage. Don't be tempted to refit the item too soon or you'll likely leave fingerprints in it or scuff the paintwork. Once it's definitely dry, you can refit it. 6

PAINTING YOUR CPU COOLER

There are usually two components of a CPU air cooler to consider – the fan and the heatsink. The fan can be sprayed in the same way as the case fan we sprayed earlier – mask off all but the hub and blades, remove any logo stickers and apply plastic primer if necessary. Use thin coats when spraying the fan to ensure the paint dries evenly and the fan doesn't end up becoming unbalanced. 1

Painting the heatsink involves a slighting different process. You don't want paint getting onto all the fins, as it will hinder cooling, but it's fine to paint the top of the heatsink, which also has the biggest visual impact. As it's made from metal, we've just used matt white spray paint from Plastikote instead of a primer, although you'll need to leave at least half an hour between coats while undercoating, compared to a few minutes for primer. Apply two or three coats of matt paint or enough so the metal colour is covered. Move the can rapidly from side to side, from a distance of 40cm, over the small heatsinks to prevent paint from building up. 2

Leave the matt coat to dry for 30 minutes, then apply the gloss colour paint spray using the same method as the previous step, moving rapidly as you spray from 40cm away. Apply three coats of paint, leaving each coat to dry for 30 minutes, or enough coats so that all the undercoat has been covered. Allow this paint to dry for an hour. Once your colour coat is dry, the fan and heatsink need some clear coat, and you'll need to add an extra-thick layer to the heatsink, as it's likely to be knocked around as you install it and other components back into the case. This coat can also help prevent the paint from peeling when the heatsink gets hot.

Allow the clear coat to dry for at least 24 hours before handling the components and reassembling the heatsink. It's also worth powering on the fan separately to check for vibrations after you've painted it. We haven't experienced this problem with any of the dozens of fans we've painted over the years, but it's always worth checking. 3

PAINTING GRAPHICS CARDS

As with motherboards, graphics cards look great with a coat of paint, but you may void your warranty or reduce its resale value. If you're still up for it, start by removing the section you want to paint.

You may be able to remove the cooler easily, but we found that detaching it from the heatsink wasn't possible, as the power cable was blocked by heatpipes.

If you can't separate the two parts, you'll need to mask off the cooler instead. We decided to spray the fan and metal details on the edge of the cooler's casing, using Frogtape to mask off the other areas before using brown tape to cover the larger area of the graphics card. 1

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As with the other components we've sprayed so far, start with an undercoat of white matt spray paint or spray primer, using at least three coats or so that the graphics card's colours are covered completely. Move swiftly from side to side as you spray from a distance of 40cm away. Allow it to dry for 30 minutes if you're using matt spray paint, or 15 minutes for normal primer, followed by three coats of gloss colour spray paint, using the same spray method but leaving for 30 minutes between each coat. You'll then need to apply the clear coat in the same way as before, then remove the masking tape after leaving it to dry for 24 hours. We decided to leave the area around the logo on the cooler visible so the silver could contrast against the black and orange colour scheme. 2

Cutting & engraving

We've combined these first few steps for cutting and engraving work, as the initial the prep work is the same. We started by creating a template in a simple paint program such as Paint.net, (available from **www.getpaint.net**), which will then be transferred onto the front panel of our case. 1

Print your design onto A4 paper and put a sheet of carbon copy paper between the A4 sheet and your case panel. By drawing over the patterns, you can then press the design onto the case panel using the copy paper. Use a ruler for any straight lines. 2

You can consider using a professional etching service from a company such as E22 for more detailed work (see p92). It's also possible to create more detailed designs from a photo. If you're using Paint.net, open your photo in the program, go to the Effects menu, then go to Outline and increase the intensity until you get a clear view of the lines you want to engrave, as shown in our aeroplane example.

You can then print out this graphic and use the carbon copy method to transfer the design onto your case. 3

The design is transferred onto your case by the dark ink in the carbon copy paper 4 – it's vivid enough to be seen and holds up well while you're brushing off any debris from the engraving process. If you need to start again, you can wipe off the ink with warm soapy water.

Engraving work is best performed with a Dremel, ideally with the Flexible Shaft Attachment tool. Use a large ball-tip engraving attachment for engraving larger areas, before using smaller ball or point-tip attachments for lines and edges. Ideally, you should test your Dremel on a hidden area of the case first, as the pressure and movement you need to apply can be affected by the thickness of the paint. It's usually best not to apply too much pressure, as doing so can gouge out ridges in the metal, especially if its aluminium. Start lightly, holding the tip at 45 degrees and moving the tip from left to right. Only use more pressure if the paint is tough to shift. 5

We've used the carbon copy method to transfer the design of our glowing acrylic front panel too. For this area, we'll be cutting out several vertical lines in the panel and placing acrylic behind them, before illuminating them with a strip of LEDs.

You'll need to spray the panel if you make a similar design, so do the engraving afterwards if you're combining the two techniques. Use a Dremel and a heavy-duty cutting disc attachment on a high speed setting to cut out your design, working your way along the marked line. Be sure to wear protective eye glasses. Alternatively, you can use a jigsaw with a metal cutting blade. To insert the blade,

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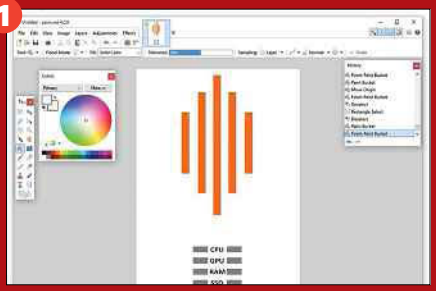

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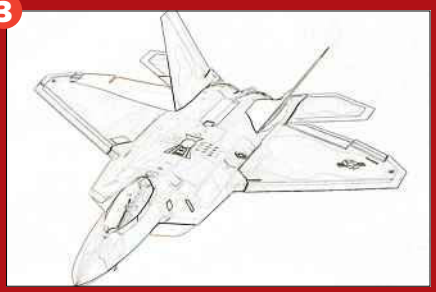


you can use a drill or Dremel to cut a pilot hole.

Don't worry too much about cutting dead-straight lines as you can use a metal file to square them off later. We've also drilled holes at the end of each line, as Dremel cutting discs are too large to cut out the end sections. 6

Use a metal file is here to create neat, equally sized holes and to rid the edges of

PAINTING SSDs

Again, don't spray your SSD if you're worried about the warranty or selling it on later. However, they're one of the easiest components to spray. Most SSD casing is made from smooth brushed metal or textured plastic, so they're ideal for spraying quickly and easily.

Start by removing any labels, then lay your SSD flat in your spray booth box, before checking for any imperfections and then applying two or three layers of matt white spray paint to cover the metal completely. Spray in a swift, sideways motion from 40cm away. 1 Your SSD will need a thick layer of paint to withstand many years of being installed in different cases, so if your SSD will be on display, apply a generous layer of gloss colour spray coat and clear spray coat. Use four coats for each, leaving each to dry for 30 minutes using the same method as the matt white spray paint. Allow the colour coat to dry for a few hours and the clear coat for 24 hours respectively. 2

However, if your solid state drive needs to slot into a drive mount in your case, where extra paint thickness could hamper installation then consider not applying paint to the areas that will come into contact with the drive mount, especially if they won't be visible anyway.

sharp fragments 7. Be prepared to spend an hour or so filing these areas, especially with a steel case. Cut out an appropriately sized piece of acrylic and use double-sided adhesive tape to stick it to the inside of the front panel behind the holes. Use the thinnest tape you can find in order to get the acrylic sheet as close to the front panel as possible. 8

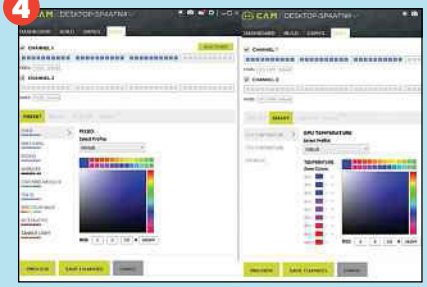
Attach an LED strip behind the panel (see the next section for more information about LED strips). In our case, the dust filter was the perfect mount for light to shine through to the acrylic section. Some LED strips are magnetic, rather than using tape, so you may need double-sided adhesive tape to fix your LED strip in place. 9

Setting up LED lighting

There are two ways to install a proper customisable lighting system. The first is to use an LED controller such as NZXT's Hue+, which can control several RGB LEDs. The other uses a motherboard with 4-pin RGB LED headers, such as Asus' Maximus VIII Hero Alpha (see p22).

The Hero Alpha has two RGB headers, 1 and includes 30cm extension cables. The cables don't work both ways around, but you won't damage any parts if you hook them up the wrong way – the LEDs just won't switch on.

The Hero Alpha uses Asus' Aura software 2 to control the two RGB headers, which are independently



configurable, as well as the motherboard's own RGB LED under the chipset heatsink. Thankfully, there's also a tick box that enables you to sync effects or colour shades across all three lights. The software is Windows-based, so you'll need to have the PC switched on and Windows installed in order for it to work.

If your motherboard doesn't have LED headers, then NXT's Hue+ RGB lighting controller is a great alternative. It has two separate lighting channels, each of which can power up to four LED strips, plus there's a host of lighting effects from which to choose. The unit itself consists of a small box 3 that's powered from a Molex connector – the setup includes several extension cables and 30cm RGB LED strips.

The Hue+ is also controlled using NZXT's software 4, in which you can choose colours from the full RGB colour palette, select numerous lighting effects and display colours for specific CPU or GPU temperatures. By daisy-chaining LED strips, you can easily illuminate a whole PC case.

We've opted to mount one LED strip in the front of the case to illuminate the front panel, then mount two more LEDs facing the interior – one in the rear corner and the other facing the CPU cooler inside 5. Of course, with RGB LEDs, you don't have to pick a specific colour; you can try different colours or just go with white for a clean look.

Custom services

If spending a weekend getting your fingers dirty, plus the risk involved with custom modding, doesn't appeal to you, there are several UK-based companies that can cut acrylic, spray your case and modify it in numerous ways, saving you the mess and fuss, and guaranteeing a professional job.

Plastic Sheets

www.plasticsheets.com

As its name suggests, Plastic Sheets offers acrylic and Perspex in a range of colours but, more importantly, it can modify even small sections of Perspex for very reasonable prices. Thicknesses range from 2mm to 30mm and you can specify the dimensions down to just 50 x 50mm. You can also order square or rounded corners, natural or polished edges and the company will even pre-drill screwholes for the easy mounting of side windows.

E22

www.e22.biz

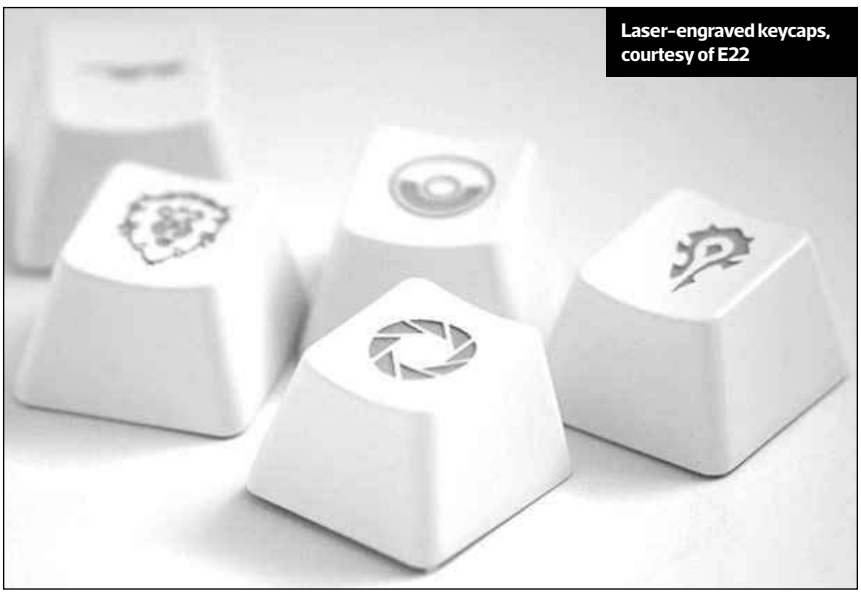
Created by modders for modders, E22 offers a range of customisation services, as well as selling loads of handy modding parts. Here we ask the company what it can do for you

CPC: What customisation services do you offer and what materials can you work with?

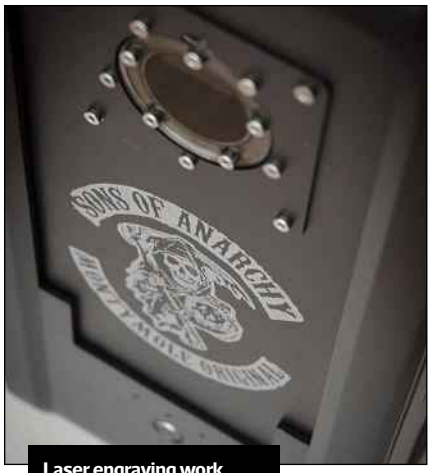
E22: We currently have a laser cutter and a CNC mill in the workshop, which can cut through soft materials such as plastics and wood, so we tend to focus on those materials. However, we also have good relationships with some local fabrication shops, we we've tackled some previous jobs using steel and aluminium.

The laser cutter is fantastic for 2D cut-out shapes, as well as high-resolution etching on any material, including metals, where it removes the paint or anodising to show the metal underneath. Recently, we've seen a large increase in the number of customers wanting parts such as radiators or windows etched with custom logos.

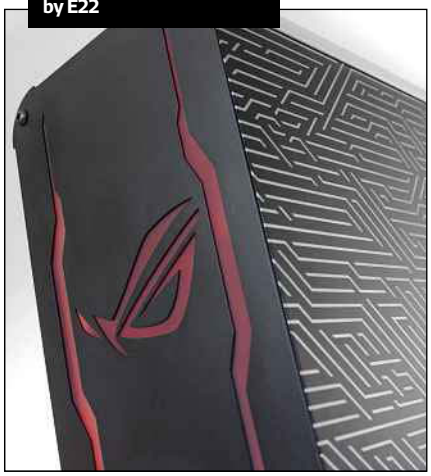
CPC: How can CPC readers get their case modified? Can they just send drawings or do



Laser-engraved keycaps, courtesy of E22



Laser engraving work by E22



they need design experience?
E22: While it's lovely to receive fully finished CAD files ready for cutting, we understand that only a very small percentage of modders have design experience, and even fewer have access to the software needed. As long as they have a rough project brief, and accurate measurements, we should be able to work with them.

CPC: What ready-made customisation products do you offer, and what are the most popular ones?
E22: We mainly focus on cable sleeving in the store, the demand for which has really sky rocketed in the past few years. At the moment, cable management combs are still proving incredibly popular, with over a quarter of a million being sold so far.

CPC: Have any prominent modders used your services?
E22: Sadly, we do most of our work behind the scenes, but in the past, we've done work for pretty much every major modder globally, and we currently provide products and custom services to most retailers in Europe.

East Coast Hydrographix

http://eastcoasthydrographix.co.uk
With its hydro dipping service, East Coast Hydrographix can professionally paint your PC case with a variety of colours and effects, with a choice of lots of lovely finishes too. Here we ask the company what it can do for you.

CPC: What objects can you paint?
East Coast Hydrographix: We spray all sorts of things, from game controllers to car parts, so we can definitely do PC cases as well.

CPC: What services do you offer?
East Coast Hydrographix: Our hydro dipping service is very popular – there are hundreds of thousands of different effects and you can mix and match panels. We can also do chrome and standard painting, lacquered and finished. We offer a highly customisable service, and there are thousands of colours and effects we can offer. We can also do a process called flocking, which results in a velvety texture that's popular on car dashboards, as well as smaller items such as game controllers and mobile phone cases.

CPC: Is there any prep work required?
East Coast Hydrographix: The parts are submerged in water, so anything electrical needs to be removed. It's an in-and-out dip, though, so generally even wood can be dipped. Also, the parts would need to be dismantled, so a computer case would need to be stripped down and all the components removed – it will then be easy to ship, which saves us time.

CPC: Would the case need to be new?
East Coast Hydrographix: Ideally, the panels would be new or free from scratches and dents – we'd need to remove blemishes before we sprayed or dipped anything, which can increase prep times and cost.

CPC: How much does it cost to spray a PC case?
East Coast Hydrographix: It's difficult to give an exact price, as all objects and paints are different and it would depend on the preparation time. Dipping can be quite involved too, as it often requires a multi-stage process with different undercoats. We haven't done many PC cases yet either, but we'd likely be able to offer a basic service for around £200 for your average-sized PC case in a range of colours. You can get an idea of the colours and effects we offer at **http://eastcoasthydrographix.co.uk/patterns.html** CPC

GARETH HALFACREE'S

Hobby tech

The latest tips, tricks and news in the world of computer hobbyism, from Raspberry Pi, Arduino and Android to retro computing

REVIEW
BBC micro:bit

Announced with great fanfare, then delayed by redesigns and hardware issues, the BBC micro:bit is the first hardware project to come out of the national broadcaster since the days of the Computer Literacy Project in the 1980s. Originally based on the CodeBug (reviewed in Issue 150), but now significantly redesigned, the micro:bit is designed to do for physical computing what the BBC Micro did for home computing.

The micro:bit design is interesting; unlike the majority of microcontrollers on the market, it uses two ARM processors: an ARM Cortex-M0 core running at 16MHz, and an ARM Cortex-M0+ running at 48MHz. It's the lower-power of these two CPUs, located in the Nordic Semi nRF51822 system-on-chip Bluetooth Low Energy module (marked 'Processor' on the informative silk screen at the rear), which actually runs your code. The more powerful chip is used only to provide USB support, and is wasted while the device is in general operation.

It's a strange design choice, but one that gives the micro:bit true cross-platform flexibility. Much like the rival mbed micro-controller range, the micro:bit appears to the host system as a USB Mass Storage device – plug it into a USB port and a removable disk appears with no need for drivers. More importantly, there's also no need to mess around installing integrated development environments (IDEs) or compiler toolchains. Everything is handled within a web browser, while compilation takes place remotely, providing a file that you simply drag and drop to the micro:bit for flashing and execution.

The micro:bit has changed since its original CodeBug-inspired design, but retains the same key features

So far, so mbed; where the micro:bit takes the lead is with its support for tablets and smartphones. Technically, it's possible to use either a micro:bit or an mbed with any device that supports USB Mass Storage devices, including mobile devices with USB On-The-Go (OTG) support. In practice, though, connecting such a device is typically awkward and can be hampered by the device's poor file management capabilities. The micro:bit's answer is Bluetooth flashing, courtesy of a smartphone application written by Samsung.

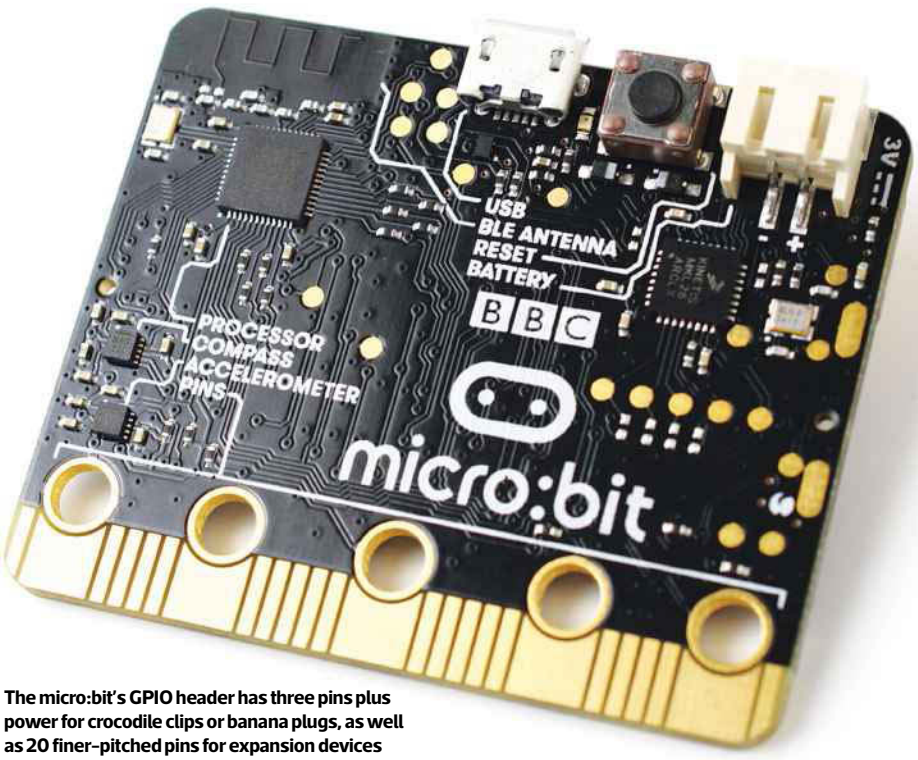
As well as being able to flash a new program onto the micro:bit entirely wirelessly, after a rather glitchy pairing process that involves an identifying pattern and PIN entry, you can also control connected Bluetooth devices. Bundled examples include the ability to flash a message onto the micro:bit's LEDs when an incoming call is detected, or using its buttons to trigger a selfie on a smartphone's front-facing camera.

It's a neat feature, if rather slow: flashing over Bluetooth took several minutes, compared to a few seconds via USB. In either case, though, you're almost certainly going to be using the web-based IDE to write your code. You have four choices here: a JavaScript IDE from Code Kingdoms; Microsoft's Touch Develop; a Scratch-style, drag-and-drop, block-based system from the same company dubbed Block Editor; and Python. In all cases, all work is performed in a browser – including, usefully, the ability to run your program on a simulated micro:bit, meaning you can test changes without flashing, and even have a go on a virtual micro:bit before the devices are readily available to buy.

At the time of writing there was one big unanswered question: pricing. Initial distribution of micro:bit units is being bankrolled by Barclays, with devices going out to every Year 7 pupil in the UK free of charge.

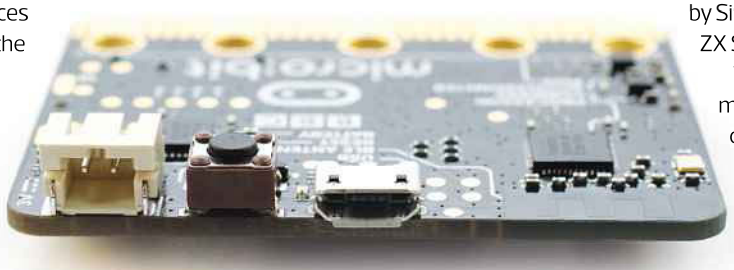
That's a good start, but so far, the BBC – which has experienced more than one delay in bringing the micro:bit to market – has been silent on the matter of commercial availability, leaving the simulator as the only way the masses can play with the micro:bit, so heaven help you if your project involves the integrated accelerometer or electronic compass functions.

Like the BBC Micro home computer before it, the micro:bit is entering a crowded market.



The micro:bit's GPIO header has three pins plus power for crocodile clips or banana plugs, as well as 20 finer-pitched pins for expansion devices

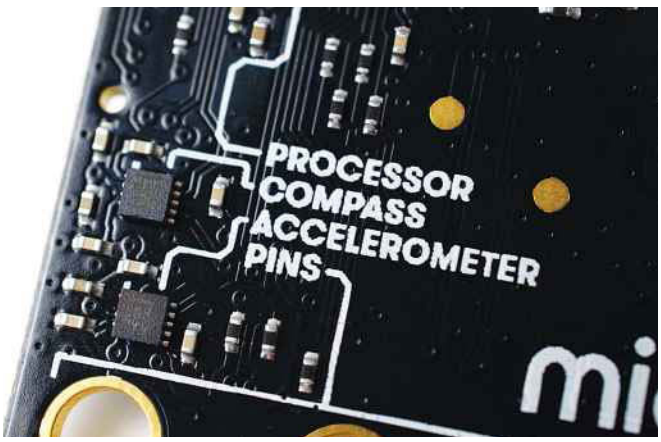
There are few devices that offer all its features in a single handy bundle, however: the mbed has the web-based IDE and drag-and-drop flashing; the Genuino 101 offers Bluetooth Low Energy support; the CodeBug shares the 5 x 5 LED matrix. Priced sensibly, the micro:bit could offer an alternative to all of these devices, but it's the price that will be the key to its success or failure outside the classroom, just like the powerful yet expensive microcomputer from which it takes half its name, and which was soundly beaten in the battle for the UK's living rooms by Sinclair's cheaper, rubber-keyed ZX Spectrum.



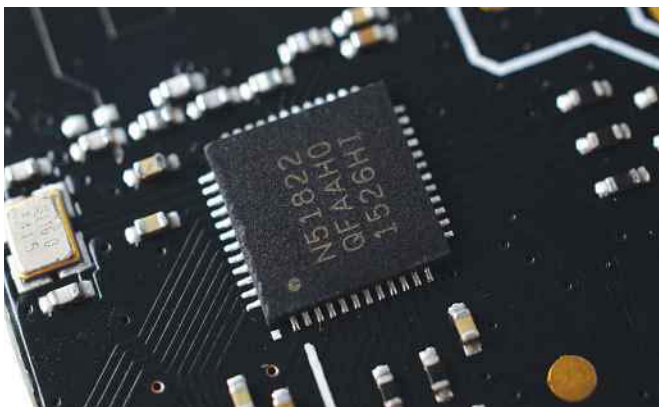
The micro:bit is entirely platform-agnostic, and appears as a removable storage device

There's one area where the micro:bit certainly has the competition beaten, however: documentation. From video tutorials to lesson plans, the BBC has ensured there's plenty of material to get you started, and with its Make It Digital programme still underway, there's no sign of the broadcaster's output slowing.

The BBC micro:bit simulator and four-language IDE is available at **www.microbit.co.uk**. Availability for the commercial micro:bit has yet to be announced.



All major components are labelled, bar the Kinetis MCU that drives the USB port



The 16MHz ARM Cortex-M0 driving the micro:bit is far more powerful than the 6502 found in the BBC Micro

REVIEW

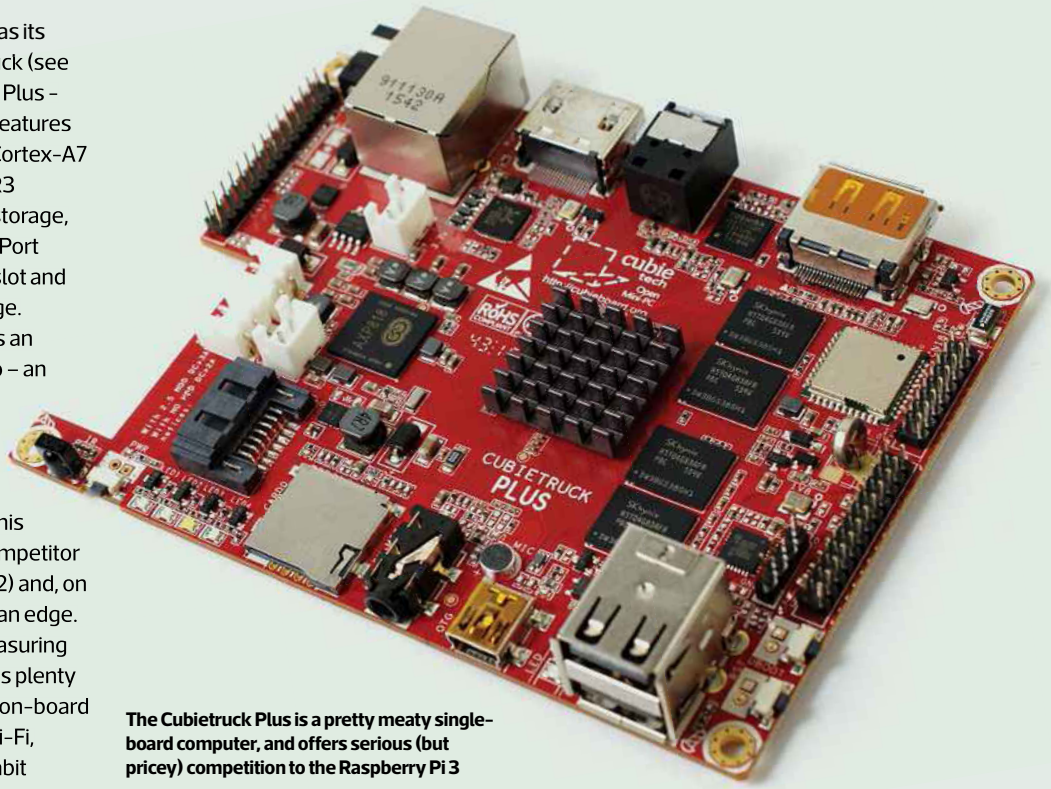
Cubietruck Plus

Based on the same design as its predecessor, the Cubietruck (see Issue 132), the Cubietruck Plus – also known as the CubieBoard 5 – features a 2GHz Allwinner H8 8-core ARM Cortex-A7 processor. There's also 2GB of DDR3 memory, 8GB of eMMC on-board storage, Gigabit Ethernet, HDMI and DisplayPort outputs, 70 GPIO pins, a micro-SD slot and SATA 2 support for additional storage.

More importantly, though, there's an on-board Wi-Fi and Bluetooth radio – an Ampak AP6330, offering 802.11a/b/g/n Wi-Fi on both the 2.4GHz and 5GHz spectrums, alongside Bluetooth 4 High Speed and Bluetooth Low Energy (BLE). This list of features makes it a natural competitor for the Raspberry Pi 3 (see Issue 152) and, on paper, the Cubietruck certainly has an edge.

While it's larger than the Pi 3, measuring 112 x 84mm, the Cubietruck includes plenty of features its rival lacks: as well as on-board storage, SATA support and 5GHz Wi-Fi, there's the DisplayPort output, Gigabit Ethernet, USB OTG support, infrared and even an on-board microphone – and that's before we get to the four additional processor cores and extra 1GB of RAM.

Benchmarking puts the Cubietruck Plus in front of the Pi 3 as well. In single-threaded tests, the Cubietruck Plus has a small but measurable lead, scoring 744 Whetstone MWIPS and 2,969 Dhrystone MIPS compared to the Pi 3's 711 MWIPS and 2,458 MIPS. The Cubietruck Plus also boasts 336MB/sec 1KB memory write and 402MB/sec 1GB memory read speeds, compared to the Pi 3's 305MB/sec and 354MB/sec respectively. In multithreaded software, the extra cores of the Allwinner H8 also shine: the Cubietruck Plus finished a SysBench CPU test in just 25 seconds compared to the Pi 3's 49 seconds, demonstrating nearly double the performance for highly parallel tasks.

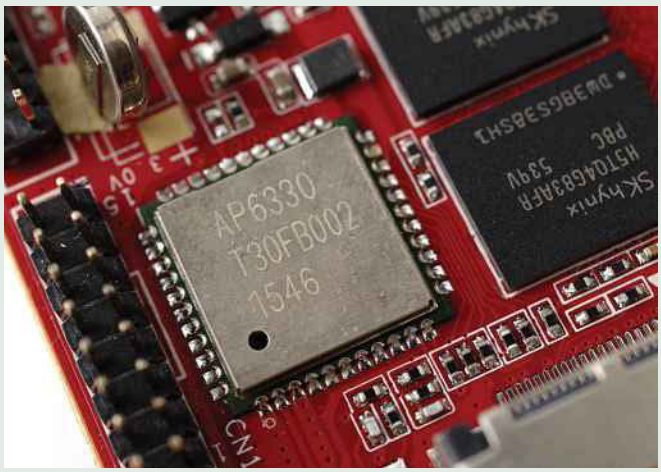


The Cubietruck Plus is a pretty meaty single-board computer, and offers serious (but pricey) competition to the Raspberry Pi 3

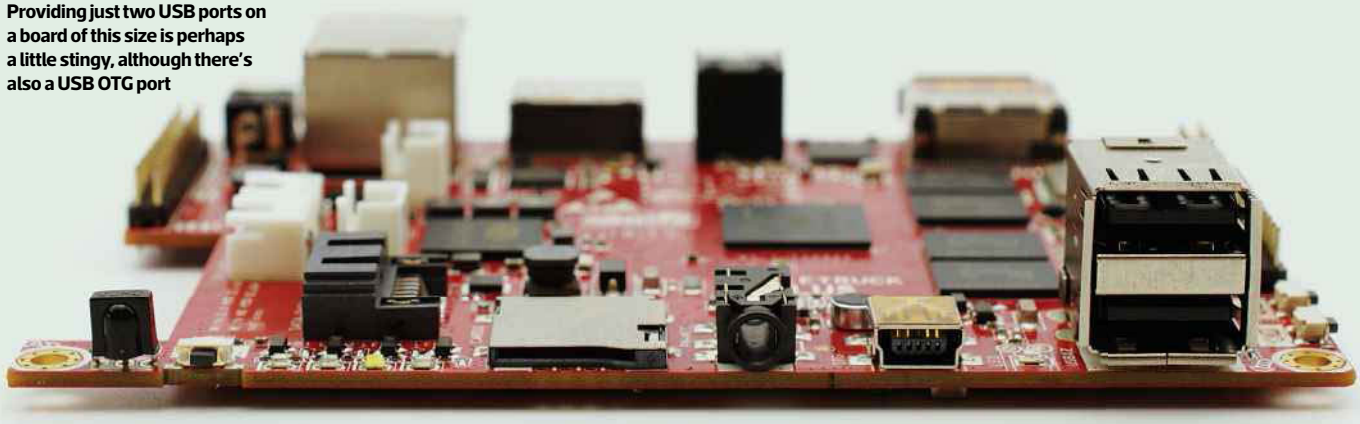
The Cubietruck Plus achieves this speed through brute force, however. The Cortex-A53 cores of the Pi 3's BCM2837 chip are undeniably more efficient than the Cortex-A7 cores used in the H8, and the Cubietruck Plus has to hit a 2GHz clock speed to gain the edge over its 1.2GHz rival.

Add the doubled core count and you end up with a direct impact on power draw: at load, the Cubietruck Plus hit 1.32A and idled at 0.75A, compared to the Pi 3's more reasonable 0.58A and 0.31A respectively for the same workload.

The Allwinner H8 system-on-chip packs eight ARM Cortex-A7 processing cores and PowerVR SGX544 graphics



An integrated radio offers Bluetooth 4 Low Energy and Wi-Fi on both the 2.4GHz and 5GHz spectrums



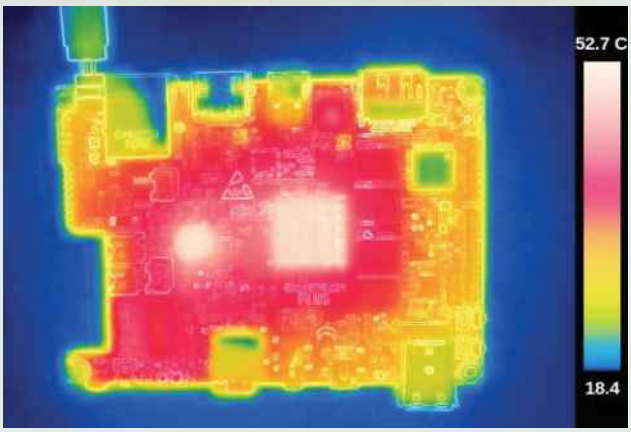
Providing just two USB ports on a board of this size is perhaps a little stingy, although there's also a USB OTG port

Interestingly, though, this extra power draw doesn't translate into excess heat. Unlike the bare bones Raspberry Pi 3, every Cubietruck Plus is supplied as a bundle that includes a small self-adhesive heatsink for the SoC. When applied, the externally measured temperature of the H8 never rose above 55˚C – a far cry from the 100˚C-plus of the Pi 3's BCM2837 when a heatsink isn't used. Strangely, though, a second chip can be seen getting just as hot as the SoC in thermal photography – the AXP818 power management controller, which allows the board to monitor and charge a connected battery.

The bundle also includes a number of other extras; a three-piece acrylic case offers space for a 2.5in SATA hard drive under the Cubietruck itself, or two drives if an optional RAID board is added. Meanwhile, the accessories box includes a USB OTG adaptor, a mini-USB cable for flashing purposes, a SATA data and power adaptor, and a USB power cable.

Software-wise, the 8GB of on-board storage is pre-loaded with a customised build of Android 4.4.2. This OS can be replaced with a customised Linaro Linux distribution for general-purpose computing tasks, and if you're going to get the most out of the board, it's a definite recommendation. Sadly, though, the version reviewed (v1.1) didn't appear to support using the GPIO headers, nor was dual-display a possibility. These features are likely to be added in future revisions, but it's worth bearing these issues in mind at the moment, and the same goes for the status LEDs, which are overly bright.

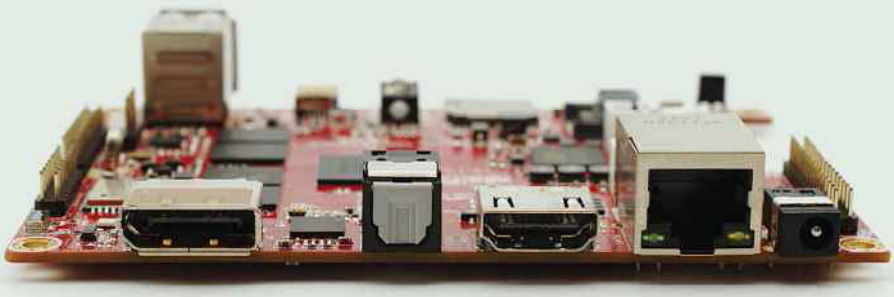
The Cubietruck Plus is impressively powerful, then, but there are one or two caveats in addition to the above to consider before leaping into a purchase. Chief among these issues is a pair of bottlenecks in the Ethernet and SATA controllers. The supposedly Gigabit Ethernet adaptor maxed out during testing at 379Mb/sec, which is admittedly higher than the 89Mb/sec of a Raspberry Pi, but still disappointingly low. Meanwhile, the SATA controller, unlike the one on the original Cubietruck, isn't native and communicates with the SoC via USB 2.



With the bundled heatsink, the Cubietruck Plus runs much cooler than a Pi 3, but that PMIC chip also gets warm

The final issue is the price. At £119.95 inc VAT, the Cubietruck Plus is four times the price of the Raspberry Pi 3 for at best double the performance. The extras in the bundle account for some of the price, as does the rough doubling of performance – but it's a steep premium if you don't need extra power, SATA, or any of the other features.

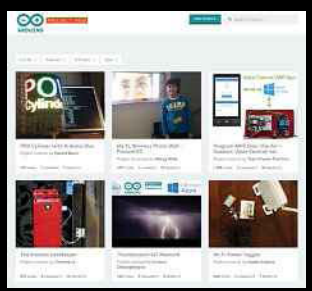
The Cubietruck Plus is available now from **www.newit.co.uk**



The original Cubietruck's VGA output has been replaced with a DisplayPort connector

NEWS IN BRIEF

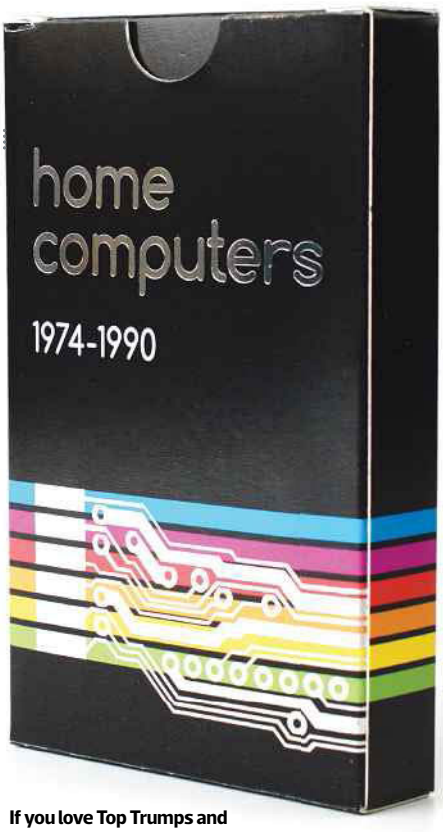
Arduino.cc launches new hubs



Aruino.cc is launching two new platforms: the Arduino Project Hub and Arduino IoT. Designed to sit below **https://create.arduino.cc**, the Project Hub offers a browsable, user-submittable database of Arduino-powered projects, powered by **www.hackster.io**. These projects range from simple tutorials through to complex multi-stage endeavours, and they're all publicly accessible. Meanwhile, Arduino IoT takes a hand-curated selection of these projects relating to the Internet of Things (IoT) and provides additional visibility.

REVIEW

8bitkick Home Computers Cards



If you love Top Trumps and vintage computing, then 8bitkick's inaugural product is for you

As a general rule, I try to steer clear of crowd-funding sites such as Kickstarter. It isn't solely because you're often putting down real money on someone else's dream with no guarantee they have what it takes to see the project through to completion, but also because I'm an absolute sucker for a gimmick and would burn through all my money in a matter of moments backing various esoteric products. A fine example being this set of vintage computing Top Trumps cards.

Neither created nor endorsed by Dubreq, Waddingtons, Winning Moves UK or any other company with a right to the Top Trumps trademark, these cards from one-man startup 8bitkick will nevertheless be familiar to fans of the game. Each card is adorned with a full colour image along with a set of statistics which can, in most cases, be directly compared for a rousing game of 'mine is bigger than yours.'

The set of cards features every machine from the Acorn Atom, the Amstrad CPC464 and Atari 400, through to the Amiga 500 and the Sinclair ZX Spectrum. There are even some esoteric entries, such as the Elektronika BK-0010, Intertec Superbrain and Exidy Sorcerer. There's also a wild card in the form of the distinctly un-vintage Raspberry Pi 2 Model B, which can admittedly trace its ancestry back to the Acorn Atom.

Each card includes the machine's CPU model, which is likely to lead to no end of arguments. After all, who could agree on whether the Z80 or 6502 should win in a showdown of 8-bit power? The other entries include clock speed, memory, maximum display resolution, maximum colour palette and the year of manufacture.

The high-quality cards are well printed, but that CPU stat is going to lead to arguments

It's the story of the cards' creation that really grabbed my interest, however. The Home Computers deck is a major victory of the commons – specifically, the Creative Commons. All images used on the cards were licensed under the permissive Creative Commons licence by their creators, which allowed the newly formed 8bitkick to put the deck together without having to track down a physical example of each machine for a photo shoot. Given the rarity of some machines, such as the never-released Commodore C65 prototype, that's just as well.

The deck itself has a Creative Commons licence too, allowing anyone to download and print a set of cards at home, or even to take the design and create extra cards for favoured machines missed out of the official deck. Cards printed above and beyond the Kickstarter orders were even donated to the Centre for Computing History in Cambridge (**www.computinghistory.org.uk**) to raise money for its conservation efforts.

While finding someone willing to play vintage computer Top Trumps with you might be a tall order, the 8bitkick Home Computers deck is a blazing success story for computer historians, crowdfunding and the entire concept of the Creative Commons.

I'm clearly not the only person to think so either: the Centre for Computing History has completely sold out of its allocation, and it's looking into printing more decks to meet demand.

More information about the 8bitkick Home Computers deck, including a print-your-own PDF download, is available from the official website at **www.8bitkick.cc** CPC

NEWS IN BRIEF

Genuino MKR1000 now available

The Genuino MKR1000 – known as the Arduino MKR1000 – has now launched, following a 1,000-unit giveaway competition late last year. Based on Atmel's ATSAMW25 SmartConnect platform, the Genuino MKR1000 is designed to compete with the Particle Photon by offering integrated Wi-Fi, security features and a breadboard-friendly DIP board layout. The biggest selling point, of course, is compatibility with the Arduino IDE and the promise that existing sketches should work out of the box. The Genuino MKR1000 is available now for €37.19 inc VAT from **https://store.arduino.cc**

Gareth Halfacree is the news reporter at www.bit-tech.net, and a keen computer hobbyist who likes to tinker with technology. @ghalfacree

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ANTONY LEATHER'S

Customised PC

Case mods, tools, techniques, water-cooling gear and everything to do with PC modding

The problem with exclusive modding contracts

There has been a gravitational shift in the PC modding scene this year. Many case companies are taking modding very seriously, perhaps too much so. There have been plenty of cases of company X refusing to let modders also work for company Y, and I've been involved in a few spats too. Modding is increasingly seen as a great way of publicising a company's products, and not just cases – the same goes for motherboards, cooling systems and even SSDs. Companies have paid professional modders to work with their cases for years, but there simply aren't enough professional modders to go around.

Clearly, if you're not sponsored or taking part in a competition then the world's your oyster – it's one reason why, even though I'm regularly asked, I refuse to take part in modding competitions. Thankfully, I usually have an excuse – I'm often hosting the competition somewhere or I'm a judge. However, I simply don't want to be tied to a single tech company either – I want to work with the best hardware, or at least the gear that floats my boat.

Many professional and popular modders are regularly coming across this issue these days. It isn't limited to cases and hardware either – water cooling is another area that's increasingly limited in terms of mixing and matching hardware when you get sponsored. That's a shame because, again, one company may make great waterblocks, but another company may offer great coolant or a particular waterblock or radiator that you would prefer to use.

It's great to see companies such as In Win flying modders from all over the world to compete in modding competitions

I can understand this strategy from the manufacturers' point of view to some extent – they obviously don't want to see gear from other manufacturers in a PC mod they've sponsored. However, asking modders to refrain from dealing with other companies completely is a step too far. Most modders that have encountered these stipulations and discussed them with me have taken issue with them. They're only paid for the project and their time – if you're not being paid a regularly salary by these companies, then you have every right to refuse a contract that makes such blanket stipulations.

If you're looking to get into professional modding, sponsorship and getting paid to create your projects, be aware that you may find yourself in this position. It's great to see modding becoming so popular that companies are spending a lot of money on competitions and sponsorship. In fact, In Win is even flying me out to Taiwan next month to cover its 2016 modding competition. Equally, though, a lot of modders are saying that some competitions are starting to take the fun out of their work.

Dune Case Kickstarter misses goal

Crowdfunding can be a fantastic way to get a project off the ground, and PCs have already benefitted from the likes of Kickstarter. The NCASE M1 mini-ITX

case, which was designed in collaboration between some PC enthusiasts and Lian Li, was successfully funded on **www.indiegogo.com** back in 2013. I've spotted several of the cases in the wild and the company is gearing up for another production run too.

I'd been following a similarly interesting project called the Dune Case on Kickstarter as well. The design clearly gets its inspiration from the current Mac Pro, with a vertical cooling arrangement and cylindrical design. However, the Dune Case can house a mini-ITX motherboard and cater for graphics cards up to 185mm long, which means it could probably accommodate some short GTX 970 cards, as well as AMD's R9 Nano. There's no option for water cooling, but low-profile air coolers up to 90mm in height can be used, so there's also scope for building a moderately overclocked Skylake system.

A lot of the attraction comes from the case's small size. It measures 26cm high and just over 20cm wide, and I love the aesthetics too. Sadly, the project fell short of its Kickstarter funding goal, but still netted over $75,000 US in pledges. Thankfully, the project's founder, Alexander Gomez, posted an update in mid-March after the Kickstarter campaign ended, stating that the project will come to market despite the missed goal on Kickstarter, so all is not lost.

Of course, the Dune Case is just one of an increasing number of cases being built by small outfits (even the NCASE was mostly created by enthusiasts), especially mini-ITX cases with unique designs. I'll be reaching out to the people behind the Dune Case and will hopefully report back with more details of when and where we might be able to get our mitts on one.

The cylindrical Dune Case can accommodate a mini-ITX motherboard and a graphics card up to 185mm long

Outsourcing your mod work

This month's Pimp my PC feature (see p84) looks at many ways you can customise your PC, including painting, engraving, and adding lighting and fan controllers. However, you don't necessarily need hundreds of pounds' worth of tools and experience to create a unique PC. There are lots of ways to add custom details to your PC – lighting is the first area to consider, as it's relatively cheap. NZXT's Hue+ RGB lighting system is a little more expensive than a set of LED strips, but it enables you to illuminate your PC in nearly any colour.

Some case manufacturers, such as BitFenix, also produce coloured accessories and even make their cases in a range of colours. The BitFenix Prodigy, for example, has a huge range of aftermarket accessories, such as dust filters, noise-insulating foam, coloured panels and aluminium logos.

In the aforementioned feature, I also briefly mentioned custom services such as painting and chassis modification, which shouldn't be overlooked. They cost more than adding lighting, for example, but they can achieve fantastic results. For example, Parvum Systems can customise its cases to suit you, and create custom acrylic parts. There's also E22 (**www.e22.biz**), which can engrave metals and cut aluminium, so if you want to create your own case using sheet metal, or just want to cut out a side window, you can simply send the parts away to be modified.

There are also plenty of services that offer case painting, as well as dipping, air brushing and wrapping. It isn't as much fun as doing it yourself, but the end result will likely be more professional and you'll have far less mess to clear away and less chance for mistakes to be made. CPC

Parvum Systems can create custom acrylic components and customise its own cases, as seen with the custom case for OCUK's Asteroid

Antony Leather is Custom PC's modding editor @antonyleather

How to Make a flight sim panel

Antony Leather shows you how to make your own mini flight sim cockpit

TOTAL PROJECT TIME / 6 HOURS

The ultimate realism when it comes to flight sims is creating a cockpit, and while most of us don't have the room for a full-sized cockpit, it's possible to use Saitek's gear to create a control panel that makes flying a range of planes in many games much more realistic.

Of course, many sims render fully working instruments, but there are also real USB instruments available, covering all sorts of gear, from artificial horizons to radio stacks and autopilots, enabling you to create replicas of many popular aircraft instrument panels. Basically, instead of fiddling around on-screen, you can use these replica panels, making for an easier, more immersive experience. In this guide, we look at a range of gear that suits a variety of titles, from combat flight sims to standard sims such as X-Plane and Microsoft Flight Simulator.

TOOLS YOU'LL NEED

Saitek flight sim modules / www.amazon.co.uk and www.scan.co.uk

Jigsaw, Dremel or coping saw / Most hardware stores

Thrustmaster MFD panels / www.maplin.co.uk

M4 nuts and screws / www.ebay.co.uk

3.2mm hardboard / Most hardware stores

Glue gun / Most hardware stores

Powered USB hub / www.scan.co.uk

1 / CHOOSE AIRCRAFT TO REPLICATE

You don't have to focus on just one specific aircraft. In fact, mixing parts can be beneficial if you use both combat and non-combat simulators. However, if you just want to replicate a Cessna 172 cockpit, for example, you can do that too. Pick the aircraft you want to replicate.

2 / SELECT HARDWARE

Some of Saitek's instruments can display multiple readouts, so you only need a few of them to cover a whole cockpit, potentially saving money. The radio stack can also be very useful if you want to use the ATC and radio navigation features in modern flight sims.

3 / DECIDE ON LAYOUT

Work out where you want all your instruments to be positioned. You'll need to consider where you'll store the panel when it's not in use, as well as the panel's position and if you want it to sit under your monitor.

4 / MEASURE SCREW LENGTH

Most of the modules have pass-through screw holes for mounting them on flat panels. You'll need to measure the length of screws you need, accounting for the thickness of the hardboard too.

5 / MARK UP BOARD

With the layout decided, place the components in their intended positions and start marking up the panel. You can use the components themselves as guides, but some of them need dismantling first, as they're designed to stand independently out of the box.

6 / CUT OUT EMM HOLE

Cut out the hole for the large engine management module (EMM) with a coping saw, jigsaw or Dremel Trio. It will require securing from the rear, as it's too deep to mount on the front of the wood board and doesn't have any mounting holes to do so anyway.

7 / CONSIDER MFD PANELS

Thrustmaster's MFD panels don't have screens, but offer dozens of programmable buttons you can assign to all manner of custom tasks. They're particularly useful for combat flight sims where you might use weapon control or radar systems.

8 / MODIFY MFD PANELS

The MFD panels need to be modified in order to be mounted on a flat cockpit panel. Start by removing the backplates and stands so that they can sit flush against the panel.

9 / REMOVE SCREW PLUGS

The panels have fake rubber screw plugs as standard, which block the holes needed to mount them on a flat instrument panel. Use a thin screwdriver to push them out.

10 / DRILL MFD PANEL SCREW HOLES

We used M4 socket cap screws with 30mm threads for all but the EMM, which needs 15mm screws. Place the panel in position and mark the hole locations with a small screwdriver. Drill with an appropriately sized drill bit to allow the screw to easily pass through the hole.

11 / CUT OUT CABLE HOLE

The MFD panels have a USB cable at their base, which needs to be routed underneath the instrument panel's board. We drilled a small recess to make room for it, and you can then secure the cable at the rear and plug it into a USB hub.

12 / INSTALL MFD PANELS

Test-fit both MFD panels, then insert the screws and fix them using M4 nuts from the other side. Keep all their other parts in the original box in case you need to return or sell them later.

13 / TEST-FIT EMM

The engine management module should slide into place with no force, but you can sand the hole a little if need be. The rest of the modules sit over their holes, but you'll need to take care to keep the EMM area neat.

14 / REMOVE DISPLAY MODULE CLIP

The display module has a metal clip at the rear, which is used to support it on a desk when it isn't used with a custom instrument panel. You need to remove it in order to mount the panel – it just clips off.

15 / MEASURE DISPLAY MODULE INSERT

The protruding part of the panel at the rear needs to insert into the hardboard, but the surrounding area needs to sit flush with the board and be screwed into place. Measure the protruding part.

16 / MARK UP DISPLAY MODULE HOLES

Mark up the board with the measurements from the display panel. It may help to line up other components around the panel to make sure it's sitting square and aligned. We only used one display panel but, even on our small board, there's room for two or three more.

17 / INSTALL DISPLAY MODULE

The display module is compatible with M4 screws, and we used the same cap head 30mm type screw types again, securing the module in place with M4 nuts.

18 / INSTALL LARGE PANELS

The larger modules install in much the same way, with four securing screw points and large protrusions at the rear. You can secure them with M4 nuts, just like the display module and MFD panels.

19 / CUT OUT TOP OF PANEL

We wanted a slight curve at the top of our panel to save space. Start by drawing a curve from one edge to the middle, above the display module. You can then cut out that half section and use it as a template to draw the curve on the other side to make a symmetrical arc.

20 / CUT OUT SUPPORTS

The engine module needs to be supported from above, and we also need to add stands to prop up the whole panel too. We cut out a support brace for the engine module, which is supported from below by two sections that also prop up the whole panel.

21 / GLUE IN PLACE

A glue gun is perfect for sticking these supports together, and proved plenty strong enough, but you could also consider using screws along with blocks of MDF. The engine module can now slide into place in the panel.

22 / DRILL ENGINE MODULE SCREW HOLES

We'll be using four screwholes with the engine module, which accept M4 screws. Line up the module and mark up the required screw holes.

23 / TEST FIT WITH SCREWS

We used 15mm M4 cap head screws to hold the engine module in place. Its weight helps to prevent the panel from falling forwards, so the whole piece ends up being quite sturdy with the rear supports too.

24 / SPRAY PANEL BLACK

You can use primer, but spraying the panel black with matt paint adds a grain effect that makes the panel look quite realistic. Apply a few coats but, as the wood is quite porous, there's little need to use a clear coat.

25 / INSERT MODULES AND FIT SCREWS

Leave the panel to dry for six hours, then fit the modules and insert the screws. The nuts can be quite stiff when you fit them the first time, so you may need pliers or a socket wrench as well as the appropriate Allen key.

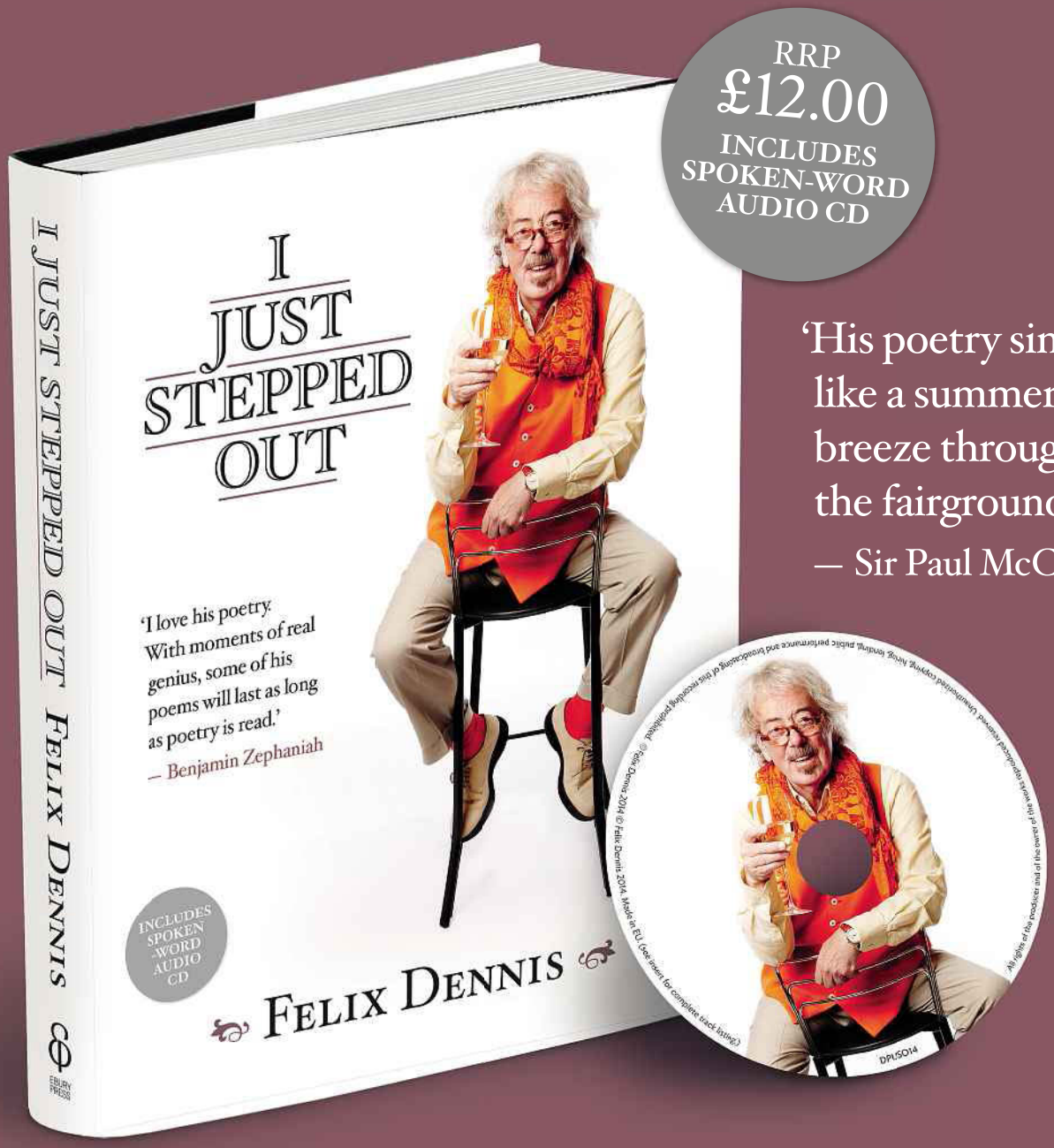
26 / FIT USB HUB

Instead of having trails of USB cables running to your PC, use a powered USB hub. This hub can be mounted to the rear of the panel, enabling you to tidy all the cables onto the panel itself. Finally, insert the display module and secure it with nuts.

27 / CHECK SUPPORT

With all the panels installed, try out the panel on your desk. The weight of the modules should mean it doesn't need more support, but it may need some extra support to prevent it from falling forwards, depending on the modules you choose. CPC

I JUST STEPPED OUT



A startlingly honest and intense collection, I JUST STEPPED OUT is a kind of 'last will and testament' in verse. Written by Felix Dennis after his diagnosis with terminal cancer, these poems chart his physical, emotional and psychological journey.

Available now from Amazon and all good booksellers.

EBURY PRESS

For more information on Felix Dennis go to: **www.felixdennis.com**

SEE THE FULL PROJECT LOG: http://tinyurl.com/TristellarWhetstone

Readers' Drives

Tristellar Whetstone

Alain Simpels made extensive mods to a Deepcool Tristellar chassis to make this water-cooled show rig, with copper pipes and a custom reservoir

/MEET THY MAKER

Name Alain Simpels
Age 32
Location Antwerp, Belgium
Occupation I work in the port of Antwerp
Main uses for PC Gaming, multimedia and showcasing my mod
Likes Game of Thrones, motorcycles pasta and PC modding
Dislikes Politics, red traffic lights and hardware failures

CPC: What originally inspired you to build Tristellar Whetstone?
Alain: When I was contacted by Deepcool about building the mod, I originally had no idea what I would make of it. After a few sketches, I found the direction in which I wanted to go. I wanted easy access to the hardware and to add an extra wow factor when you opened the side panels. Making this mod look different from the original design would also require new front grilles, and here I was inspired by the new BMW F30 grille inspired me, which I thought would give the mod a more spacey look.

CPC: Where does the Whetstone name come from?
Alain: From Asus' Whetstone mouse pad. The print on the mouse pad inspired me to use it on the outside of the mod, adding more texture.

CPC: What specs did you choose and why?
Alain: The mod was specially made for CES 2016 in Las Vegas and I suggested the hardware to Deepcool. I mainly wanted to get a GTX 980 into the build so that the card would be displayed in the top section, which had to be heightened. The rest of the kit – the motherboard, CPU and PSU – are mid-range. For storage, I simply used a 250GB SSD, which is sufficient for a PC that's showcased at events.

CPC: What difficulties did you come across?
Alain: The first problem I had to solve was getting easy access to the hardware without having to place the case on its side to remove one of its panels. I came up with the idea of remaking all the panels on the outside, so I could make my own system to access the hardware. I contacted a good friend and asked if he could bend a few aluminium panels for me, which would be used at the bottom of the case. The remaining panels would be made from Plexiglas and used as windows, making the hardware visible from the outside. To mount the Plexiglas panels on the aluminium panels, I had to design a hinge so the top panels could be opened and provide clear access to the hardware.

The other challenge was water-cooling all the parts in such a cramped case. I could easily do it using flexible tubing, but I chose to use coppers pipes to match the theme of this build. Before I could mount all the water-cooling parts, I had to check every option for laying the copper pipes. As it was almost impossible to keep all the pipes inside the case, I decided to route the pipes through the

SYSTEM SPECS

CPU Intel Core i5-4590

Graphics card EVGA GTX 980 OC

Case Deepcool Tristellar

Memory 16GB Corsair Platinum 1600MHz

Motherboard Asus Z97I-Plus

Storage 256GB Crucial BX100 SSD

PSU Deepcool DA650W

Cooling Custom water-cooling loop, featuring Watercool Heatkiller IV pro Copper NI CPU waterblock, Watercool Heatkiller IV XL GTX980 Acryl NI GPU waterblock, DDC-1 Plus 12V pump, EK-DDC X-TOP V2 Plexi pump top, Bitspower Pump Cooler/Heatsink pump house, custom reservoir and EK-Coolstream XE 120 radiator

panels, adding an extra eye-catching feature.

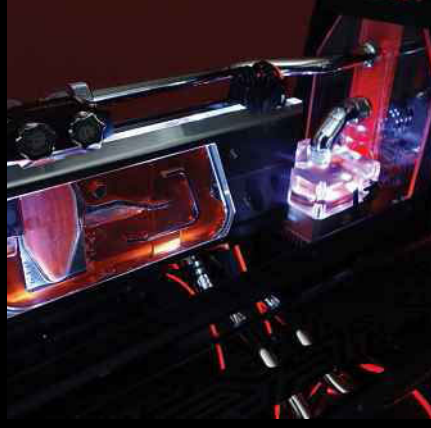
CPC: What materials did you use?
Alain: I used 4mm Plexiglas for the outside, as it's cheap, easy to work with and I know it quite well from previous mods. For the base of the build, I used 4mm aluminium that matches the thickness of the Plexiglas. Once both materials are painted, you can't see the difference between them once the case is built. For the custom reservoir, I used 5mm Plexiglas to ensure that it would be strong enough to survive all the trips to different events.

CPC: What tools and machinery did you use?
Alain: Only a few parts of this mod were made by machine. The aluminium panels, which were made by Pascal de Greef (aka modder Paslis), were cut to the right size and then bent at right angles. The remaining panels were made from Plexiglas – it was fine to use my scroll saw and Dremel on this material to make small cut-outs in the frame. All these tools are very easy to handle, even if it's your first time; you just have to focus your saw on following the line you've drawn on the object.

CPC: How long did it take to build Tristellar Whetstone?
Alain: The project was built in less than four months. Due to the deadline, I had to speed up some parts so the case would be ready in time for CES 2016, where it would be displayed at the Deepcool stand.

BE A WINNER

To enter your machine for possible inclusion in Readers' Drives, your mod needs to be fully working and, ideally, finished based in the UK. Simply log on to **www.bit-tech.net** and head over to the forums. Once you're there, post a write-up of your mod, along with some pics, in the Project Logs forum. Make sure you read the relevant rules and advice sticky threads before you post. The best entrant each month will be featured here, where we'll print your photos of your project and also interview you about the build process. Fame isn't the only prize; you'll also get your hands on a fabulous selection of prizes – see the opposite page for details.



CPC: What did you learn from the build process?
Alain: Making a reservoir from scratch was pretty challenging. The first step was the design, which had to fit with the front grille. The next task was to saw all the pieces at correct 90-degree angles. When all the pieces were made, I had to sand the edges to get them smooth and ready to glue. I used acrylic cement for glue – it's perfect for making reservoirs, as the bond between the parts only gets stronger over time.

Less challenging, but still tricky, was the process of bending the Plexiglas. Since the heating and bending process is delicate, you need to take your time over this job. You need to make sure the material heats up evenly, without overheating, or you'll get burn marks on the Plexiglas. Also, when bending large curves around a mould, the material will stretch and get a few millimetres bigger.

CPC: What other mods have you built?
Alain: I've completed seven different projects. The design of the first one, Project Umbrella, was inspired by the fictional Umbrella Corporation in the Resident Evil games. The second project, Black Obsession, was requested by a friend and saw me using copper pipes in a water-cooling loop for the first time.

The next one was Project White, which saw me bringing the idea of using nickel-plated copper pipes in a water-cooling loop to the modding community. Entering this mod in several contests turned out to be a winning experience. Next up was CM Silencio 550 Limited Edition, which was specifically designed for a contest. It ended up using a mix of different features from my previous builds, including the copper pipe water loop, the use of Plexiglas, the top reservoir and the concept of a transparent case.

Next was Grafit, which had an open design and fully custom top reservoir that stood out with the case's two-tone colour. Then there's Eden, a case mod inspired by the G5 case where the wood effect is the main eye catcher. Finally, there was Purpura, for which I used an old Dell XPS 720 case. I redesigned the whole inside of the case with new panels and a custom, Persian-inspired ventilation print. You can check out all my previous projects at www.simplicitydesigns.biz

CPC: Are you happy with the end result, and is there anything you'd do differently if you built it again?
Alain: I have no regrets about this build. If I built it again, I would do it exactly the same way. I love all the details on this mod, from the copper pipes to the custom wires and (most of all) the Whetstone print. CPC

Win all these prizes!

We've teamed up with some of the world's leading PC manufacturers and retailers to offer this great range of prizes to each lucky Readers' Drives winner. If your creation is featured in the magazine then you'll walk away with all of the prizes listed on this page, so get in your entries!

Corsair graphite Series 230T case and RM 550w Modular power supply

TOTAL VALUE £150 inc VAT / **MANUFACTURER** www.corsair.com

Corsair believes that a great PC starts with a great case. The Corsair Graphite Series 230T is a compact expression of this core philosophy. With stylish looks and a choice of three different colours, it packs in a remarkable number of features to provide builders with tonnes of room for expansion and amazing cooling potential. Like all Corsair cases, it's built using the finest materials and finished to the highest standards, so it will withstand several years of upgrades. Plus, to make sure it stand outs from the crowd, the 230T features Corsair's new Air Series LED high-airflow fans, providing distinctive lighting with low-noise, high-airflow cooling.

Just as a quality case is essential to building a quality PC, a high-performance, a high-quality power supply is also a vital ingredient. The all new RM series has been built from the ground-up to deliver unmatched reliability alongside 80Plus Gold efficiency, and all with the absolute minimum of noise. It uses specially optimised quality parts to reduce sound at the component level, and it's completely silent below 40 per cent load, thanks to its Zero RPM fan mode. It's also fully modular, allowing for the maximum amount of flexibility during installation. With a Corsair Graphite 230T case and an RM 550W Modular power supply at the heart of your build, you'll have the foundations for a truly awesome gaming machine.

Mayhems coolant and dyes

VALUE £50 inc VAT / **MANUFACTURER** www.mayhems.co.uk

Cooling performance is only one part of the equation when it comes to kitting out your rig with custom water-cooling gear. The other major bonus is that all those tubes and gleaming fittings just make your PC look damn sexy, and they look even better when they're pumped full of fancy coloured coolant. As such, we're particularly pleased to have the folks at Mayhems now on board with Readers' Drives; they're currently offering two 1-litre bottles of Mayhems' Pastel Ice White coolant, along with a selection of five dyes, so you can choose the colour that best complements your PC. Check out the blue coolant in our own mini PC mod on the cover of Issue 109 for an example of what's possible with some Mayhems coloured coolant.

Phobya Modding Kit

VALUE £50 inc VAT **MANUFACTURER** www.phobya.com, www.aqua-tuning.co.uk

The Phobya modding kit is designed with the modder in mind, offering great value for money and quality products. The kit includes Nano-G 12 Silent Waterproof 1,500rpm multi-option fans, which use an innovative fan-blade design. As standard, the fans include braided black cables to keep your case looking as neat as possible. The fans are also supplied with a special cable that lets you run the fan at 5V rather than 12V, reducing the noise emitted in order to help you to build a silent system.

The kit also includes the 60cm Phobya 3-pin Molex to 4x 3-pin Molex Y-cable. This pre-braided extension cable gives you extra routing options in your case, and it also enables you to run up to four fans from one compatible motherboard header. Meanwhile, the Phobya SATA 3 cables included in the kit offer the same great quality braiding as the rest of the Phobya range, while also securing your connection with latched connectors. As well as this, the kit includes the Phobya SlimGuide Controller, which gives you the option to vary the speed of other fans in your case, while the Phobya TwinLEDs let you shine a light on your mods.

DOWNLOAD FROM WWW.ASUS.COM/CAMPAIGN/REALBENCH

CUSTOM PC REALBENCH 2015

in association with ASUS

Give your PC a workout with our new benchmark suite, and see how your rig compares to other readers' machines

BENCHMARK YOUR PC

Download the benchmarks from www.asus.com/campaign/Realbench and, before you run them, disable any power-saving technologies in your BIOS that change your CPU clock speed, or the leaderboard won't record your overclock frequency properly. To post a score on the leaderboard, go to Save Upload File in the RealBench 2015 app's Results menu, and save your results in an RBR file. You need to select Offline Uploads on the leaderboard site, sign up for an Asus account and upload your file.

Gimp

We use Gimp to open and edit large images. Unlike our previous Gimp test, this one uses more than one CPU core, although it's still more sensitive to clock speed increases than more CPU cores.

Handbrake H.264 video encoding

Our heavily multi-threaded Handbrake video encoding takes full advantage of many CPU cores, pushing them to 100 per cent load.

LuxMark OpenCL

This GPU compute test is the only synthetic part of our suite, although the renderer is based on the real LuxRender physically based rendering software. As 3D rendering is a specific workload that not everyone will use, and because OpenCL support isn't standard in most software, this section is given just a quarter of the weighting of the other tests in the final score.

Heavy multi-tasking

Our new multi-tasking test plays a full-screen 1080p video, while running a Handbrake H.264 video encode.

Scores

RealBench 2015 breaks down the scores for each test, then gives you a total system score and a percentage reference score.

On an Intel system, the 100 per cent reference score comes from a stock-speed Core i7-4790K, with 16GB of Corsair 2,400MHz DDR3 memory, a 240GB OCZ 150 SSD, an Asus Maximus Gene VII motherboard and an Nvidia GeForce GTX 780 3GB graphics card.

On an AMD system, the 100 per cent reference score comes from a stock-speed A10-7850K APU, with 8GB of Corsair 2,133MHz DDR3 memory, a 256GB Plextor M5 Pro SSD and an Asus A88X-Pro motherboard, using the APU's integrated graphics. CPC

SHOUT OUTS!

This month's main shout out goes to Terrystone1, who stormed onto the leaderboard at number five with his 4.61GHz Core i7-5960X, producing an incredible score of 216,006. We assume that new entry TEL at number seven is also the same person. If that's you, get in touch as we'd love to talk to you about your system.

CHROME WARNING

At the moment, Google's Chrome browser flags up the RealBench 2015 download as potentially harmful, and we're aware of this issue. The file is perfectly safe, however – please ignore this warning.

CUSTOM PC REALBENCH 2015 LEADERBOARD

RANK	SYSTEM SCORE	REFERENCE	USERNAME	MOTHERBOARD	CPU	CPU CLOCK	MEMORY	PRIMARY GPU
1	275,683	240.9%	8pack	Asus Rampage V Extreme	Intel Core i7-5960X	5.5GHz	16GB Kingston 3000MHz	Nvidia GeForce GTX Titan X
2	233,375	203.9%	ian.parry3	Asus Rampage V Extreme	Intel Core i7-5960X	4.6GHz	32GB G.Skill 3200MHz	Nvidia GeForce GTX Titan X
3	221,477	193.5%	Chris_Waddle	Asus Rampage V Extreme	Intel Core i7-5960X	Not reported	16GB Corsair 2666MHz	Nvidia GeForce GTX Titan X
4	219,415	191.7%	Luke@DinoPC	Asus Rampage V Extreme	Intel Core i7-5960X	4.6GHz	16GB Corsair 3276MHz	Nvidia GeForce GTX Titan X
5	216,006	188.7%	terrystone1	Asus Rampage V Extreme	Intel Core i7-5960X	4.61GHz	16GB Corsair 2992MHz	Nvidia GeForce GTX 980 Ti
6	215,694	188.5%	dubai1	Asus X99-Pro/USB 3.1	Intel Core i7-5960X	4.7GHz	32GB Corsair 2800MHz	Nvidia GeForce GTX 980 Ti
7	212,062	185.3%	TEL	Asus Rampage V Extreme	Intel Core i7-5960X	4.62GHz	16GB Corsair 2750MHz	Nvidia GeForce GTX 980 Ti
8	211,331	184.6%	Menthol	Asus Rampage V Extreme	Intel Core i7-5960X	Not reported	32GB G.Skill 3200MHz	Nvidia GeForce GTX 980 Ti
9	206,723	180.6%	stuart	Asus Rampage V Extreme	Intel Core i7-5960X	4.41GHz	16GB Corsair 3000MHz	Nvidia GeForce GTX 780 Ti
10	201,446	176.0%	CustomPC	Asus Rampage V Extreme	Intel Core i7-5960X	4.3GHz	16GB Corsair 2666MHz	Nvidia GeForce GTX Titan X
11	198,971	173.9%	?	Asus Rampage V Extreme	Intel Core i7-5960X	4.4GHz	64GB Corsair 2400MHz	Nvidia GeForce GTX 980 Ti
12	197,964	173%	Carbonleg	Asus X99-E WS	Intel Core i7-5960X	Not reported	32GB Corsair 2400MHz	AMD Radeon R9 200 Series
13	189,230	165.3%	shadowsrayne	Asus Rampage V Extreme	Intel Core i7-5960X	4.2GHz	32GB Corsair 2133MHz	Nvidia GeForce GTX 980
14	185,219	161.8%	dax	Asus Rampage V Extreme	Intel Core i7-5960X	3.97GHz	32GB Corsair 2448MHz	Nvidia GeForce GTX 980
15	181,058	158.2%	richcardnpaul	ASRock EP2C602	Intel Xeon E5 2670	3.3GHz	32GB Kingston 1866MHz	AMD Radeon R9 200 Series
16	179,386	156.7%	mboogie	Asus Rampage V Extreme	Intel Core i7-5960X	4.2GHz	32GB Crucial 2133MHz	Nvidia GeForce GTX 980
17	177,350	155.0%	mauserk98	Asus Rampage V Extreme	Intel Core i7-5930K	4.63GHz	16GB Team Group 3000MHz	AMD Radeon R9 200 Series
18	175,745	153.6%	dis80786	Asus Rampage V Extreme	Intel Core i7-5930K	4.4GHz	16GB Corsair 2666MHz	Nvidia GeForce GTX 970
19	173,154	151.3%	mark.gee93	Asus Rampage V Extreme	Intel Core i7-5930K	4.49GHz	12GB Corsair 3168MHz	Nvidia GeForce GTX 980 Ti
20	172,828	151%	mdottwo	Asus Rampage V Extreme	Intel Core i7-5820K	4.4GHz	16GB G.Skill 2766MHz	AMD Radeon R9 200 Series

Folding@Home

Join our folding team and help medical research

MILESTONES THIS MONTH

USERNAME	POINTS MILESTONE
BasketballSpurs	20000
Jusan	20000
PCEnthusiastUK	20000
Nitro3d	30000
ewink20	40000
NickCPC	50000
AJJackson1	60000
Goldmaster	60000
AMDftw!	70000
BP_Evil_Element	100000
Girder_Gibbon	100000
Petersheed	100000
trma97	100000
UnluckyGeorge	100000
bradbooth	200000
The_Notorious_Pizza_Boy_(Mike2)	200000
TroyS2	200000
Fersigo	400000
NFGCS	400000
pig_farmer_uk	400000
crazeey	600000

USERNAME	POINTS MILESTONE
For_Those_We_lost	600000
Atanamir	700000
Ayeska	700000
Reaperman	700000
Derek_Conlon	800000
dixy999	800000
The_FFrey	800000
BigD-lite	900000
CTHW	1000000
deserbaker	1000000
PeteUKLancs	1000000
Rob_Johnson	1000000
Tango_Echo_Alpha	1000000
The_Notorious_Pizza_Boy_(Mike)	1000000
LEACHIE007	2000000
Maverick	2000000
mort6dav3	2000000
PatStar	2000000
NoizDaemon666	3000000
wew	3000000
Stormcrow	4000000

USERNAME	POINTS MILESTONE
GreenPig	5000000
ittoms	5000000
andysroms.com	6000000
Bobthetoolnut	6000000
Ganey	7000000
QuasarGreg	7000000
RaistlinRTCW	7000000
RDL_Mobile	7000000
valkynaz	7000000
Acanuck	10000000
bigrew	10000000
kcanti	10000000
Shirty	10000000
gupsterg	20000000
adbygrave	30000000
cauliflower1	30000000
Oatyflapjack	40000000
Unicorn	40000000
Little_Willie	50000000
Qazax	50000000
SirBenjaminNunn	50000000
sonic_vortex	60000000

USERNAME	POINTS MILESTONE
Petaflops	70000000
Portchylad	70000000
slowpurple	70000000
Tattysnuc	90000000
Andy_J	100000000
Cmaxx	100000000
madmatt1980	100000000
Sean_Hayes	100000000
Roveel	200000000
Laguna2012	400000000
johnim	500000000
PC_Rich	600000000
coolamasta	900000000
DocJonz	2000000000
Andy_J	90000000
Cmaxx	90000000
madmatt1980	90000000
daxchaos	100000000
PcShedTV	100000000
Desertbaker	300000000
Lordsoth	500000000
Scorpuk	800000000

WHAT IS FOLDING?

Folding@home uses the spare processing cycles from your PC's CPU and graphics cards for medical research. You can download the client from **http://folding.stanford.edu** and our team's ID is 35947. Once you pass a significant milestone, you'll get your name in the mag. You can also discuss folding with us and other readers online at the **www.bit-tech.net** forums.

TOP 20 OVERALL

RANK	USERNAME	POINTS	WORK UNITS
1	Nelio	2,595,319,985	190,876
2	DocJonz	2,076,858,998	191,245
3	HHComputers	1,451,975,392	47,220
4	coolamasta	912,640,714	185,143
5	piers_newbold	894,663,940	54,912
6	Scorpuk	866,491,018	33,992
7	PC_Rich	622,213,003	85,846
8	StreetSam	571,113,589	90,231
9	Lordsoth	570,991,219	102,559
10	johnim	503,853,637	82,689
11	Slavcho	483,253,928	38,261
12	Dave_Goodchild	465,923,185	119,946
13	Laguna2012	420,124,297	27,192
14	The_M2B	398,574,250	63,554
15	Desertbaker	318,696,103	22,330
16	KevinWright	280,794,501	32,921
17	apeman556	265,085,847	31,254
18	Dickie	258,976,224	18,198
19	phoenicis	250,044,587	95,660
20	TheFlipside	244,713,945	24,747

TOP 20 PRODUCERS

RANK	USERNAME	DAILY POINTS AVERAGE	OVERALL SCORE
1	HHComputers	5,720,954	1,451,975,392
2	DocJonz	4,196,096	2,076,858,998
3	Scorpuk	1,681,860	866,491,018
4	Lordsoth	1,462,531	570,991,219
5	piers_newbold	1,431,547	894,663,940
6	daxchaos	1,108,960	145,035,482
7	Nelio	1,057,139	2,595,319,985
8	Laguna2012	946,043	420,124,297
9	madmatt1980	932,985	115,143,789
10	apeman556	814,143	265,085,847
11	PC_Rich	688,938	622,213,003
12	Slavcho	654,776	483,253,928
13	BeezaBob	558,350	147,928,478
14	KevinWright	452,322	280,794,501
15	Andy_J	413,054	107,656,337
16	The_M2B	412,257	398,574,250
17	Desertbaker	392,743	318,696,103
18	coolamasta	365,588	912,640,714
19	Tattysnuc	339,554	99,947,285
20	Maverick	338,088	2,635,307

JAMES GORBOLD / HARDWARE ACCELERATED

SAVED BY PC GAMING

The overall PC market is in decline, but gamers and content creators are keeping the PC industry alive, argues James Gorbold

I've just come back from a week-long visit to The Hague, where Intel was hosting its annual Solutions Summit. ISS is an invite-only event for Intel's largest partners and it's used by Intel to communicate its strategy, market outlook and roadmaps for the year ahead. While much of the information discussed at ISS is under NDA and therefore can't be revealed in **Custom PC**, with hundreds of manufacturers attending, the conference is a great opportunity to take the pulse of the PC industry.

A key takeaway from ISS this year was that, although the tablet market is now saturated and sales are declining, the desktop PC market is still shrinking as both businesses and consumers choose to wait longer before refreshing their systems. The laptop market isn't doing too well either, with sales continuing to decline for many of the same reasons as the desktop market.

That said, there are segments of the desktop market that are performing extremely well – specifically PC gaming and content creation. Gaming is booming, with research by companies such as SuperData showing that digital PC game sales generated over $32 billion US revenue in 2015, from a total (digital sales on all platforms) of $61 billion US, making the PC the highest-earning gaming platform in the world, far larger than mobiles or consoles. Content creation is also driving demand, primarily thanks to the increasing popularity of professional-looking video streams from video makers on YouTube and the like.

The end result is that, while desktop CPU sales continue to decline, sales of Intel's K-series CPUs are growing, as they provide the highest bang per buck, especially when overclocked. Intel is hoping to repeat this model for success in the laptop business with the Core i7 6820HK, the first overclockable mobile CPU. Laptops with this new CPU are now beginning to appear on the market and it will be very interesting to see if it takes off.

This trend towards more sales of higher-end CPUs is also changing the nature of the PC market, with local brands being far more successful at targeting gamers and content creators than established, multinational firms. It's a trend that's been happening for a number of years, but it's becoming increasingly apparent as the PC market matures.

> The PC is the highest-earning gaming platform in the world, far larger than mobiles or consoles

The end result is that component and PC manufacturers are having to invest more time and money than ever into developing new high-end products and services, away from the declining traditional PC market. Intel, for example, has some great new products lined up for content creators over the coming months. While I can't go into product details at this stage, some tasks such as high bit-rate 4K video editing, which can realistically only be performed on dual Xeon workstations costing upwards of £4,000 at the moment, will be much more accessible in the near future.

VR will accentuate this trend towards high-end products too, as you need a very powerful PC not only to play VR games but also to create VR content. That said, while I'm a big fan of the HTC Vive, and VR is undoubtedly the next big thing in gaming, I don't think we've seen the killer VR app yet that's required to make it the must-have upgrade of 2016.

Either way, the good news is that PC gaming isn't just alive and well, but it's positively booming. The overall PC market might be in decline, but our corner of it is looking very healthy indeed. CPC

James Gorbold has been building, tweaking and overclocking PCs ever since the 1980s. He now helps Scan Computers to develop new systems.

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